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Composition of the Edible Portion of Raw (Fresh or Frozen) Crustaceans, Finfish, and Mollusks. II. Macroelements: Sodium, Potassium, Chlorine, Calcium, Phosphorus, and Magnesium

VIRGINIA D. SIDWELL, DAVID H. BUZZELL,
PAULINE R. FONCANNON, and AUDREY L. SMITH

ABSTRACT—This report summarizes data from 128 references on sodium, potassium, calcium, phosphorus, chlorine, and magnesium levels found in the flesh of 161 commonly eaten seafoods.

INTRODUCTION

Sidwell et al. (1974) described a data bank that is being established at the Southeast Utilization Research Center, NMFS, NOAA, on the chemical and nutritional composition of seafoods. In that publication the investigators outlined the system that is being employed for the management and retrieval of the data, as well as a summary of the data on protein, fat, moisture, ash, carbohydrate, energy (calories), and cholesterol from 155 references on 154 commonly eaten seafoods.

The primary objectives for the data bank are: 1) to develop a comprehensive, systematic data retrieval system containing available information on the chemical and nutritional composition of fish and fishery products; 2) to publish as completely as possible information on the nutrients found in fishery products; and 3) to point out areas in chemical composition of fish needing further investigation.

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The objective of this second report is to present a resumé of available data on sodium, potassium, chlorine, calcium, phosphorus, and magnesium in seafoods. There is a need in the medical community for information on the amounts of the various macroelements, especially sodium, found in marine animal flesh, in order to calculate sodium restricted diets.

DISCUSSION

Thus far in our literature search, we have located 128 articles that contain suitable data for the elements sodium, potassium, calcium, phosphorous, chlorine, and magnesium in 161 species of finfish, crustaceans, and mollusks that are commonly eaten throughout the world.

Each investigator reported an average figure obtained either from several determinations on a composite of fish, or from a single determination on each of a number of fish. In the latter instance, the scientist reported the average and the range of the results obtained from the analyses. These averages were used to calculate the average and standard error of the mean.

The range of values for each element in fish of the same species is sometimes quite extensive, as may be observed in Table 1. A portion of this variation is undoubtedly due to seasonal and biological differences, i.e. the size of the animal, its age, sex, degree of sexual maturity, and the amount of each given macroelement in its diet.

Part of the variation in the sodium and potassium concentrations in fish flesh may be associated with the differing analytic methods applied by the various laboratories to obtain their values. Also, freshwater fish tend to have a slightly lower sodium content than do saltwater fish. Sodium content is even higher in crustaceans and mollusks.

Calcium and phosphorous are constituents of the bones of finfish. The bones are generally removed by the analyst to prepare a sample for chemical analysis. It is very difficult to remove all of the bone and therefore the cause of some of the variability in the calcium and phosphorous content of fish of the same species may be due to how well the bone has been removed.

Many species of finfish and shellfish shown in Table 1 have only one or two values, and in many instances none, for a specific macroelement. In such cases, the few values available will give only an estimate of macroelement content; more data are needed to obtain a value which possesses any degree of reliability.

Table 1.—Composition of the edible portion of raw (fresh or frozen) crustaceans, finfish, and mollusks. II. Sodium, potassium, calcium, phosphorous, chlorine, and magnesium.

	Sodium	Potassium	Calcium	Phosphorous	Chlorine	Magnesium	References
			mg/100 g				
Abalone Haliotidae spp.			[1]27±6 [2]21—34 [3]2			[1]112±62 [2]50—175 [3]2	37, 44, 59 106
Amberjacks and Yellowtails *Seriola* spp.	[1]76±12 [2]52—90 [3]3	[1]438±158 [2]280—597 [3]2	22±6 6—35 5	[1]162±40 [2]102—253 [3]3	20 1	35±2 30—40 3	26, 44, 59, 72, 106, 109, 127
Anchovies Engraulidae spp.	115±23 70—147 3	356±51 267—511 5	194±46 20—480 9	239±18 188—349 8	[1]138±55 [2]30—214 [3]3	41±12 29—54 2	23, 24, 44, 59, 60, 72, 80, 82, 103, 125
Barracudas Sphryaenidae spp.	89±43 46—132 2	252±48 155—307 3	40±7 22—70 8	328±60 156—598 8	230 1	31±4 27—35 2	20, 22, 44, 45, 59, 61, 72, 103, 109
Basses, sea Serranidae spp.	71±8 30—112 11	332±37 138—580 13	48±7 7—140 17	205±12 150—375 20	105±15 90—135 3	24±6 10—40 4	7, 11, 20, 22, 23, 26, 34, 44, 45, 59, 61, 65, 72, 76, 103, 121, 125
Basses, temperate Percichthyidae spp.			71±61 10—132 2				11, 34, 61
Brills Bothidae spp.			30±0 30—30 2	204±0 204—204 2			44, 59
Butterfishes Stromateidae spp.	94±7 81—106 3	346±52 203—434 4	96±39 17—314 8	300±43 159—506 8			20, 22, 44, 45, 59, 61, 72, 103, 109
Butterflyfishes Chaetodontidae spp.	104±3 101—108 2	263±47 216—310 2	37±11 12—57 4	140±8 116—153 4	120 1		34, 44, 59, 80
Caesios Caesionidae spp. (in Lutjanidae)	59 1	391±127 264—519 2	35±1 34—36 4	274±97 165—565 4			44, 59, 103
Carps Cyprinidae spp.	59±6 43—105 11	295±18 174—435 17	52±6 12—182 45	318±16 165—605 54	37±10 30—45 4		4, 7, 21, 22, 37, 43, 46, 49, 50, 59, 72, 76, 80, 85, 88, 91, 92, 108, 112, 121
Catfish, air-breathing Clariidae spp.	59±2 55—63 2	309±86 147—440 3	35±6 18—51 5	231±46 116—375 5	130 1	33 1	44, 46, 47, 59, 80, 85, 91
Catfishes, sea Ariidae spp.	79±24 55—103 2	322±109 109—468 3	71±26 14—98 9	208±27 148—440 10	110 1	34 1	24, 44, 59, 60, 61, 80, 82, 86, 102
Cavefishes Amblyopsidae spp.			550 1	350 1			91
Characins Characidae spp.			173 1	266 1			45
Cichlids Cichlidae spp.	52 1	454 1	68±23 37—112 3	173±90 39—344 3			59, 61, 86
Clams, mactra Mactridae spp.			42 1	325 1			59
Clams, razor Solenidae spp.		143 1	60 1	204±6 198—210 2			11, 59
Clams, tellin Tellinidae spp.	262 1	164 1	121 1	83 1			59
Clams (species unknown)	190±10 180—200 2	137±56 35—228 3	99±9 59—144 14	156±19 90—350 14		43±11 20—70 4	5, 6, 11, 13, 15, 39, 44, 56, 59, 65, 71, 76, 106
Cockles Cardiidae spp.	200 1	197 1	167±51 116—217 2	93±15 78—122 3			44, 59, 66

Table 1, continued.

	Sodium	Potassium	Calcium	Phosphorous	Chlorine	Magnesium	References
			mg/100 g				
Cods Gadidae spp.	82±1 60—180 10	364±17 270—465 11	16±2 9—20 7	212±31 9—240 8	228±173 55—400 2	23±3 20—25 2	7, 11, 15, 21, 26, 27, 37, 39, 59, 65, 66, 68, 69, 71, 76, 95, 104, 107, 113, 121
Crabs, blue *Callinectes sapidus*		188 1	94±11 71—133 5	152±30 38—205 5		30±5 12—38 5	54, 81, 128
Crabs, deep sea *Neptunnis* spp.		134 1	174±10 20—202 3				33, 44
Crabs, Jonah *Cancer borealis*	276 1	279 1	96 1	12 1		45 1	55
Crabs, king *Paraiithodes camtschatica*		55 1	160 1				59
Crabs, Samoan *Scylla serrata*			118±45 53—290 5	209±65 130—402 4			33, 44
Crabs, Tanner *Chionoecetes tanneri*	120 1	520 1	140 1	220 1		130 1	26
Crabs, Miscellaneous spp.	262±78 95—453 4	233±63 111—322 3	94±22 29—120 4	233±40 171—350 4	117 1	48 1	22, 29, 59, 65, 107
Crayfish Miscellaneous spp.	121±61 60—182 2	302±35 239—500 7	39±5 16—58 8	239±36 101—560 11	280 1	60±20 40—80 2	11, 26, 31, 44, 56, 57, 59, 60, 71, 73, 76, 97
Croaker Sciaenidae spp.	109±27 70—160 3	259±45 180—336 3	42±8 18—89 8	232±43 125—444 8	178±68 110—246 2	30 1	10, 26, 44, 59, 72, 76, 82, 97
Cusk *Brosme brosme*			20 1	220 1			107
Cusk eels and brotulas Ophidiidae spp.			66 1	345±200 145—545 2	110 1		45, 72
Cutlassfishes Trichiuridae spp.	94 1	330 1	75±47 13—214 4	301±90 160—542 4	100 1	25 1	24, 53, 59, 72, 109
Cuttlefish Miscellaneous spp.		239±35 204—273 2	27 1	143 1			59, 76
Dace Cyprinidae spp.		270 1					37
Dagol *Chorinemus toloo*			16 1	424±26 398—449 2	750 1		72, 97
Damselfishes Pomacentridae spp.				728 1	140 1		72
Dolphins Coryphaenidae spp.	170±72 98—242 2	370 1	15 1	143 1			59, 127
Dories Zeidae spp.	60 1	241±90 151—330 2	40 1	181±51 130—231 2	70 1	20 1	26, 72, 76
Drepanes Drepanidae spp.	88 1	373 1	57±18 30—90 3	183±27 149—235 3			44, 59, 61
Drums Sciaenidae spp.	67±5 51—84 7	273±8 226—301 8	37±12 16—57 3	113±88 25—200 2		24 1	21, 61, 83, 109, 112, 121, 125
Eels, conger Congridae spp.	50 1	241±41 200—282 2	71±31 20—50 4	270±40 180—390 5	100 1	20 1	26, 59, 61, 72, 125

Table 1, continued.

	Sodium	Potassium	Calcium	Phosphorous	Chlorine	Magnesium	References
	mg/100 g						
Eels, freshwater Anguillidae spp.	79±3 76—81 2	362±118 214—712 4	62±25 15—188 4	293±52 196—501 5	64±7 40—80 5	22±4 16—30 3	25, 59, 61, 66, 71, 72, 76, 106
Eels, moray Muraenidae spp.	25 1	165 1	41±22 19—63 2	251±141 83—532 3	57±33 24—90 2	15 1	44, 80, 90
Eels, pike conger Muraenesocidae spp.	88 1	490 1	70±43 27—112 2	243±38 205—280 2			59, 97
Eels, snake Ophichthidae spp.	62±24 38—86 2	358±44 314—401 2	43±8 14—140 20	274±27 95—509 21	95 1	34 1	3, 4, 11, 44, 46, 49, 52, 59, 80, 88, 91
Eels, spiny Notacanthidae spp.	50 1	270 1	34±10 22—55 3	248±74 174—322 2	223 1	27 1	46, 49, 80
Eels, swamp Flutidae spp.	116 1	172 1	40±10 30—50 2	126±33 93—158 2			59
Featherbacks *Notopterus* spp.	40±6 34—45 2	190±71 119—260 2	73±18 40—180 7	317±39 161—450 8	106 1	32 1	46, 49, 59, 80, 85, 91, 92
Flatheads Percophididae spp.	66±26 40—91 2	291±101 190—392 2	44±13 18—79 4	204±28 174—260 3		19±9 10—27 2	26, 44, 59, 109
Flounders, left eye Bothidae spp.	100±32 54—160 3	220 1	63 1	313±66 185—401 3	235±5 230—240 2	44 1	7, 59, 66, 67, 83
Flounders, right eye Pleuronectidae spp.	61±7 35—99 12	316±22 157—394 11	27±3 17—36 6	182±29 116—250 4		24±5 10—31 4	17, 21, 22, 66, 76, 101, 107, 109, 119, 121, 125
Flounders Unknown spp.			17 1	175 1	176 1	49 1	11, 71, 108
Flyingfishes and halfbeaks Exocoetidae spp.	85±14 70—112 3	407±81 250—516 3	94±37 30—229 5	260±72 140—614 6	90 1	20 1	26, 44, 59, 72
Gillrakers Chirocentridae spp.			22 1	1,150 1			97
Goatfishes Mullidae spp.	59±8 40—74 4	316±5 311—320 2	72±17 23—97 4	246±33 170—340 6	143±3 140—150 3	30 1	44, 59, 72, 80, 125, 127
Gobies Gobiidae spp.	92±30 50—150 3	294±58 250—360 3	92±47 15—370 7	324±47 151—554 9	178±72 106—250 2	28 1	44, 45, 59, 72, 80, 91, 97, 97, 103
Goosefishes Lophiidae spp.		297 1	13±6 7—19 2	334±132 180—597 3	370 1		59, 72, 125
Greenlings Hexagrammidae spp.	58±2 52—62 8	411±17 352—478 7	34±12 12—55 3	173±8 165—180 2		18 1	7, 13, 21, 59, 68, 69, 109, 113, 121
Grunts Pomadasyidae spp.	71±1 70—72 2	230±30 200—260 2	55±27 9—268 9	194±21 110—285 8	500 1	10 1	22, 26, 34, 37, 44, 59, 61
Guitarfishes Rhinobatidae spp.			11±2 9—12 2	257 1		24 1	59, 109
Gurnards, flying Dactylopteridae spp.	80 1	300±14 260—320 4	65±20 22—104 4	179±27 130—222 3		21±1 20—22 2	26, 59, 76, 109, 125
Haddock *Melanogrammus aeglefinnus*	57±2 49—67 8	342±26 299—434 5	19±3 10—30 5	208±46 164—318 9		24 1	3, 7, 11, 19, 21, 35, 60, 66, 71, 76, 81, 102, 107, 121
Hagfishes Myxinidae spp.	136 1	114 1	4 1	160 1	141 1	26 1	90

Table 1, continued

	Sodium	Potassium	Calcium	Phosphorous	Chlorine	Magnesium	References
			mg/100 g				
Halibut Pleuronectidae spp.	64±3 36—112 46	398±8 318—475 34	23±8 13—30 4	216±14 192—253 4	88 1	23 1	7, 11, 12, 21, 27, 59, 60, 66, 68, 71, 93, 102, 107, 109, 111, 121
Herrings Clupeidae spp.	103±15 49—183 10	348±47 25—512 10	142±35 21—460 17	324±21 134—742 42	173±42 108—291 4	38±8 30—46 2	7, 11, 18, 22, 23, 24, 27, 29, 32, 56, 59, 60, 61, 65, 66, 68, 69, 71, 72, 76, 87, 94, 107, 125
Jacks Carangidae spp.	68±8 54—89 4	431±44 340—550 4	45±8 16—93 11	237±37 150—565 10		34±4 30—37 2	20, 26, 44, 59, 61, 109
Kingfishes *Menticirrhus* spp.	85±2 83—87 2	250 1					83
Lampreys Petromyzontidae spp.		183 1	10 1				59, 76
Lings *Molva* spp.			20 1	200 1			107
Lizardfishes Synodontidae spp.	70 1	390±124 266—513 2	30±9 13—49 4	291±56 201—445 4	110 1	29 1	44, 59, 72, 103, 109
Loaches *Misgurnus anguilli-caudatus*		496 1	28 1	402 1			59
Longaray Ambassidae spp.			67 1	150 1			44
Lumpfishes and snailfishes Cyclopteridae spp.	69 1	485 1	56 1	203 1	33 1		59
Mackerels Scombridae spp.	90±14 30—252 15	320±27 136—471 16	58±11 5—343 35	267±25 148—778 33	105±39 35—170 3	30±3 25—40 4	9, 11, 21, 22, 24, 26, 34, 36, 39, 44, 45, 53, 59, 62, 66, 71, 72, 76, 78, 81, 88, 97, 103, 106, 107, 108, 121, 124, 125, 127
Minnows Cyprinidae spp.			140 1	180 1			59
Mojarras Gerreidae spp.	107 1	404 1	65±34 6—122 3	231±40 191—312 3			44, 45, 59
Mullet Mugilidae spp.	73±6 52—100 7	303±11 259—356 7	40±8 11—99 16	258±21 140—436 19	131±21 120—152 2	29±2 25—33 5	1, 7, 21, 24, 26, 34, 44, 46, 53, 59, 60, 61, 72, 76, 80, 81, 88, 91, 92, 97, 103, 109, 121, 127
Mussels Mytilidae spp.	91±30 11—140 4	327±107 121—480 3	105±30 71—164 3	145±15 102—170 4			19, 24, 26, 59, 66, 71, 75
Needlefishes Belonidae spp.	79 1	397±1 396—397 2	72±26 21—98 3	251±50 121—362 4	140 1		44, 59, 72, 76, 88
Nemipterids Nemipteridae spp.	88 1	500 1	57±27 15—135 4	198±12 173—210 3		28 1	44, 59, 109
Octopuses Mixed spp.	363 1	232 1	28±8 12—39 3	109±25 66—151 3			59, 60
Oysters Ostreidae spp.	160±78 73—618 4	248±111 90—570 4	98±16 39—210 14	153±14 76—265 14	42 1	32±7 12—230 6	11, 15, 22, 26, 39, 44, 56, 57, 59, 60, 71, 65, 76, 81, 95, 126
Parrotfishes Scaridae spp.			54±18 36—90 3	167±23 143—213 3			44, 45, 59

Table 1, continued.

	Sodium	Potassium	Calcium	Phosphorous	Chlorine	Magnesium	References
			mg/100 g				
Perches Percidae spp.	63±3 50—80 3	264±13 210—324 12	30±0 30—30 2	168±29 110—230 4		20±0 20—20 2	7, 11, 21, 26, 37, 43, 76, 112, 121
Perches, climbing Anabantidae spp.	43±7 35—64 4	323±50 195—438 4	68±22 13—131 5	228±38 159—390 7	101±5 96—106 2	34±2 32—35 2	44, 59, 80, 85, 91, 92
Periwinkles Littorinidae spp.		102 1					66, 76
Pickerels Esocidae spp.					606 1		72
Pikes Esocidae spp.	52 1	329±50 174—590 7			227 1	175±27 148—202 2	7, 11, 37, 71, 76
Plaice Pleuronectidae spp.	91±8 83—98 2	312±18 277—333 3	20 1	220 1		25 1	17, 65, 66, 76
Pomfrets Bramidae spp.		517 1	132±109 23—240 2		223±83 140—305 2		59, 72, 92
Porgies Sparidae spp.	77±6 40—110 12	291±29 156—488 13	44±6 15—123 20	291±25 117—580 27	119±13 90—190 8	27±3 20—31 3	7, 11, 20, 21, 26, 44, 59, 72, 76, 83, 103, 109, 121, 125
Puffers Tetraodontidae spp.		347 1	18 1	138 1			59
Rays, eagle Myliobatidae spp.				179 1	275 1		24
Rays, electric Torpedinidae spp.					671 1		72
Rays, stingray Dasyatidae spp.	156±23 133—179 2	294±58 236—352 2	19±3 9—25 7	129±11 99—170 7		38 38 1	19, 44, 59, 61, 97, 108
Roaches Cyprinidae spp.		270 1					37
Sablefishes Anoplopomatidae spp.	56 1	358 1	77 1	187 1			13, 113
Salmon, Australian Arripidae spp.	57±6 50—60 3	240±6 230—250 3	37±3 30—40 3	183±29 150—240 3		27±3 20—30 3	26
Sanddab Citharichthys spp.	397 1	220 1	25 1	110 1		44 1	35, 45
Sandfishes Trichodontidae spp.			61 1	184 1			59
Sandlances Ammodytidae spp.		377 1					76
Sardines Clupeidae spp.	90±6 60—128 10	218±73 25—420 5	134±19 28—380 21	350±28 39—580 27	138±7 115—164 6		16, 20, 24, 39, 44, 53, 58, 59, 61, 71, 72, 81, 89, 97
Sauries Scomberesocidae spp.	60 1		22±0 22—22 2	190±0 190—190 2		50 1	39, 59, 105
Sawfishes Pristidae spp.			54 1	238 1			60
Scad and mackerel Carangidae spp.	71±7 53—94 5	487±127 360—614 2	46±8 12—71 9	279±63 115—680 10	86±29 28—120 3	24±8 20—37 3	19, 20, 24, 32, 44, 53, 59, 60, 61, 72, 106, 109, 127

Table 1, continued.

	Sodium	Potassium	Calcium	Phosphorous	Chlorine	Magnesium	References
			mg/100 g				
Scallops Pectinidae spp.	182±19 163—200 2	278±58 162—340 3	78±38 40—115 2	270±38 210—340 3		30±10 20—40 2	11, 19, 26, 65, 66, 71, 76
Scorpionfishes Scorpaenidae spp.	65±2 45—94 32	366±12 269—432 19	18±3 15—20 2	229±64 60—327 4	75±5 70—80 2		7, 21, 27, 59, 79, 107, 111, 113, 120, 121
Sculpins Cottidae spp.	55 1	332 1					19
Sea chubs Kyphosidae spp.	50 1	268±42 226—310 2	38±2 36—40 2	335±79 227—488 3	240 1	20 1	11, 26, 103
Sea Cucumbers Mixed species				67 1	14 1		59
Searobins Triglidae spp.					296 1		72
Seatrout Sciaenidae spp.	59±0 59—60 3	305±12 280—317 3	40 1	120 1			21, 26, 127
Shad Clupeidae spp.	69±15 54—98 3	274±56 162—330 3	108±16 22—127 6	203±28 39—323 11	216±40 140—276 3	41 1	11, 21, 45, 53, 59, 61, 72, 76, 91, 97, 109, 121
Sharks, dogfish Squalidae spp.	100 1	223±49 174—272 2	13±3 7—16 3	253±27 176—300 4		20 1	53, 59, 65, 66, 76, 105
Sharks, hammerhead Sphyrnidae spp.			20±5 15—25 2	163±45 118—208 2		20 1	44, 97, 106
Sharks, mackerel Lamnidae spp.			13 1	161±54 107—214 2	150 1		72, 97
Sharks, requiem Carcharhinidae spp.	70 1	290 1	34±8 5—59 7	204±58 150—309 9	150 1	27±17 10—44 2	9, 26, 44, 45, 59, 72, 106
Sharks, sand tiger Odontaspididae spp.	79 1	549 1	68±48 9—164 3	211±26 141—288 5	140 1		24, 34, 59, 72
Sharks, thresher Alopiidae spp.				349 1	120 1		72
Sheathfishes Siluridae spp.			49 1	152 1			59
Shrimps and Prawns Mixed species	132±22 45—220 7	248±40 118—410 8	142±18 16—550 45	239±21 127—912 44		54±11 23—111 7	9, 14, 15, 22, 24, 26, 27, 29, 39, 44, 45, 56, 59, 60, 61, 65, 66, 71, 73, 81, 85, 91, 97, 98, 100, 107, 108, 110, 125
Siganids Seganoidae spp.	76 1	450 1	41±0 41—41 2	122±0 122—122 2			44, 59
Silversides Atherinidae spp.				105 1			60, 66
Skates Rajidae spp.	97±7 90—103 2	303±42 250—387 3	67±3 64—70 2	199±50 131—296 3	210 1	30	19, 26, 59, 72, 76
Smelts Osmeridae spp.	156±25 80—214 5		317±200 50—750 3	245±55 190—680 3	112±13 86—137 4	24 1	11, 39, 43, 59, 63, 66, 71, 95
Snails Mixed species	91±18 68—146 4	179 1					44, 59, 61, 76

Table 1, continued.

	Sodium	Potassium	Calcium	Phosphorous	Chlorine	Magnesium	References
			mg/100 g				
Snake mackerels Gempylidae spp.	101±21 80—122 2	360 1	70 1	270 1		59±19 40—78 2	26, 29
Snappers Lutjanidae spp.	78±10 33—150 11	285±27 125—373 9	32±5 14—65 10	248±42 120—527 10	220 1	24±4 20—28 2	7, 11, 20, 21, 22, 26, 34, 44, 45, 59, 60, 71, 72, 81, 83, 102, 110, 121, 127
Snooks Centropomidae spp.	71±3 66—80 4	308±63 193—477 4	33±6 14—54 8	191±31 89—400 10		25±5 20—30 2	24, 26, 34, 44, 59, 60, 82, 85, 91
Slimys and Soapies Leinognathidae spp.	146±16 130—162 2	344±65 218—437 3	42±6 19—52 6	272±79 148—554 5			44, 53, 59, 103
Soles Pleuronectidae spp.	85±4 56—163 27	344±12 253—475 20	21±6 12—32 3	249±98 105—436 3		31 1	7, 21, 61, 68, 81, 103, 111, 119, 121
Soles Soleidae spp.	80 1	220±28 168—262 3	29±7 18—47 4	271±27 230—349 4	80 1	25±3 20—30 3	26, 65, 72, 76, 109, 125
Spadefishes Ephippidae spp.	94±4 90—98 2	331±39 292—370 2	61±9 37—74 4	223±20 191—280 4		40 1	26, 44, 45, 59
Squids Mixed species	176 1	275±20 246—313 3	50±11 10—109 8	221±41 153—420 6		20 1	44, 45, 59, 76, 106, 125
Squirrelfishes Holocentridae spp.	70 1						127
Stargazers Uranoscopidae spp.					357 1		72
Sturgeons Acipenseridae spp.					466 1		72
Suckers Catostomidae spp.	53±1 50—59 8	313±9 292—344 7	15 1	165 1			7, 21, 34, 112, 121
Sunfishes Centrarchidae spp.	116 1					38 1	95, 103, 127
Surgeonfishes Acanthuridae spp.	91±31 60—122 2	327±111 192—546 3	38±12 21—45 4	324±90 169—503 4			44, 59, 103, 127
Swordfishes Xiphiidae spp.	102 1	342 1	13 1	228 1	130 1		59, 72
Tarpons Elopidae spp.	82±0 82—82 2	426±66 360—491 2	66±9 54—92 4	211±28 113—263 5			24, 44, 59
Therapons Theraponidae spp.	83 1	345±129 216—474 2	48±4 40—59 4	280±78 193—435 3			44, 59, 103
Threadfins Polynemidae spp.			67±25 10—117 6	214±33 148—398 7			9, 24, 44, 59, 61, 97
Tilefishes Branchiostegidae spp.			40 1	217 1			59
Tonguefishes Cynoglossidae spp.		489 1	29 1	164 1			59
Triggerfishes Balistidae spp.	50±20 30—70 2	265±75 190—340 2	35±5 30—40 2	130±0 130—130 2		25±5 20—30 2	26
Trout, cisco Salmonidae spp.	108±29 38—320 9	329±19 280—358 4	12 1	206±54 152—260 2		17 1	8, 21, 37, 81, 112, 121

Table 1, continued

	Sodium	Potassium	Calcium	Phosphorous	Chlorine	Magnesium	References
				mg/100 g			
Trout, grayling *Thymallus arcticus*				142±41 101—182 2			37
Trout, salmon Salmonidae spp.	56±2 24—127 88	340±92 139—500 80	82±21 8—249 18	268±17 125—360 18	29 1	52±11 15—99 10	7, 11, 12, 14, 15, 27, 37, 38, 56, 59, 64, 68, 69, 71, 76, 77, 81, 92, 101, 105, 106, 107, 109, 111, 114, 115, 116, 121
Trouts Salmonidae spp.	43±8 26—77 6	395±30 227—555 13	23±8 12—38 3	221±23 152—315 8	100 1	29±3 26—32 2	7, 11, 37, 43, 59, 60, 66, 71, 76, 84, 105, 107, 117, 122
Trout, whitefish Salmonidae spp.	52±1 52—53 3	307±10 297—317 2		310 1	351 1		7, 29, 66, 112, 121
Tunas Scombridae spp.	66±5 31—188 44	363±7 252—518 42	30±8 6—93 12	348±44 190—760 17	162±39 35—280 5	50 1	7, 20, 21, 24, 39, 40, 44, 48, 57, 59, 61, 72, 76, 82, 107, 111, 121, 122, 127
Turbot Pleuronectidae spp.	68 1		49 1	203 1			11, 27, 60, 72, 76
Viperfish Chauliodontidae spp.	150 1	250 1	51±8 43—58 2	118 1	112 1	29±0 25—32 2	80, 81
Weevers Trachinidae spp.		213 1		423 1	50 1		72, 76
Whale, sperm *Phyester macrocephalus*		360 1					76
Whelks Mixed species		89±51 38—140 2	34 1	58 1			59, 66, 76
Whiting Sillaginidae spp.	84±34 50—118 2	326±66 260—457 3	45±11 16—71 5	169±12 130—253 5		21±1 20—21 2	24, 26, 44, 59, 71, 92, 109
Wrasses Labridae spp.	50 1	390±32 358—422 2		432±69 388—615 3	83±12 50—100 4		22, 72, 76

[1] Standard error of the mean.
[2] Range.
[3] The number of averages used.

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MFR PAPER 1229

Red Snappers of the Carolina Coast

CHURCHILL B. GRIMES, CHARLES S. MANOOCH III,
GENE R. HUNTSMAN, and ROBERT L. DIXON

A valuable recreational headboat[1] fishery operating from North Carolina and South Carolina ports takes large quantities of fishes typical of Caribbean reefs and banks. The bulk of the catch is provided by porgies, groupers, grunts, and snappers. Of these, snappers, especially red snappers, are considered the greatest trophies. Red snappers are renowned because they are usually large, are very game fighters, and are among the finest of all fish on the table. The term red snapper in the recreational fishery includes four different fishes all belonging to the family Lutjanidae: red snapper, *Lutjanus campechanus* (Fig. 1) silk snapper, *L. vivanus* (Fig. 2); blackfin snapper, *L. buccanella* (Fig. 3); and the vermilion snapper, *Rhomboplites aurorubens* (Fig. 4). Three others, the yellowtail snapper, *Ocyurus chrysurus*, the wenchman, *Pristopomoides aquilonaris*, and cubera snapper, *Lutjanus cyanopterus*, occasionally appear in headboat catches, but are not important in the fishery.

Snappers are related to the porgies (*Sparidae*) and grunts (*Pomadasyidae*) and are distinguished from the latter families by presence of teeth on the vomer in the roof of the mouth. Snappers are carnivorous, usually bottom-dwelling fishes that are represented by approximately 250 species distributed throughout the tropical and subtropical regions of the world's oceans. About 15 species occur in the western Atlantic. The presence of snappers, and other tropical reef fishes, as far north as Cape Hatteras (lat. ≈ 35°N) is permitted primarily by two factors: 1) numerous areas of rocky substrate on the outer Continental Shelf and along the shelf break, and 2) year-round warm water resulting from the influence of the Gulf Stream.

Recreational fishermen on headboats, private, and charter vessels catch red snappers by fishing on the bottom in depths ranging from 13 to 80 fathoms. Sinkers varying from 8 to 50 ounces are used along with 5/0 to 9/0 hooks. In deeper water, electric reels are often used to reduce the labor of fishing. The usual bait is cut squid, although chunks or whole fish seem slightly more effective for taking large snappers and groupers.

In this paper, we wish to describe briefly the four red snappers of the Carolina coast, their life histories, and salient aspects of the Carolina fishery for these species. These and other species appearing in the fishery are currently under investigation by the Bottom Fishery Task, Atlantic Estuarine Fisheries Center, National Marine Fisheries Service, NOAA, Beaufort, N.C.

RED SNAPPER

The red snapper is the most valuable of the snappers in commerce and recreation. It is known off North Carolina and South Carolina as the "genuine" or "real American" red snapper, and sometimes erroneously as the mutton snapper. This red snapper is easily distinguished from the other red snappers of the Carolina shelf. It differs from the vermilion snapper in being much more deep-bodied, not as streamlined, and in lacking irregular golden lines on the sides. The silk, or yelloweye snapper, has a bright yellow iris while that of the red snapper is red. The blackfin snapper has a prominent black spot at the base of the pectoral fin which is absent or much reduced on the red snapper.

The red snapper is found from North Carolina south to Key West, around the entire Gulf Coast to the Campeche Banks. A closely related species, the Caribbean red snapper, *Lutjanus purpureus*, occupies the shelf areas bordering the Caribbean southeastward to Brazil. Neither the red snapper nor the

Clockwise from lower left are Gene R. Huntsman, Charles S. Manooch III, Churchill B. Grimes, and Robert L. Dixon, all of the Atlantic Estuarine Fisheries Center, National Marine Fisheries Service, NOAA, Beaufort, NC 28516. Dixon's 168-lb warsaw grouper was taken off Beaufort on 8 April 1975.

[1]Boats which charge by the individual, thus on a "head" basis.

Caribbean red snapper are reported from the Bahamas.

Adult red snapper occupy moderate depths on the Outer Continental Shelf (OCS). Off North Carolina and South Carolina they are usually found at depths of 25 to 50 fathoms (46-91 m) over both high and low relief hard bottom. In the Gulf of Mexico the species is reported from 18 to 80 fathoms (33-146 m), but is most abundant at about 40 fathoms. In this area, red snapper apparently move into shallower water during the warmer months and offshore in winter. Adult red snapper occupy rough-bottom, reef-type habitats; juveniles may occur on a smooth bottom. Red snapper sampled from headboats in the Carolina recreational fishery have ranged in weight from 1.9 to 35 pounds and in length from 13.7 to 35.7 inches. The average red snapper landed weighed approximately 17 pounds. Most of the red snapper taken are large, and catches of small ones (<5 pounds) are unusual. Catches of red snapper off the Carolinas are so irregular that it is difficult to ascertain whether or not they move inshore seasonally.

Red snapper are opportunistic bottom feeders, taking a wide variety of invertebrates and fishes. Tunicates, coelenterates, crabs, shrimps, and small fish are important foods, but as they grow larger, fish are eaten more often.

Spawning both in the Gulf of Mexico and off the Carolinas appears to extend through the warmer months. Researchers in the Gulf of Mexico report females as small as 10 inches (255 mm) and males as small as 9 inches (230 mm) with maturing gonads. Off Texas, young red snapper are trawled frequently in shallow water of about 13 fathoms (24 m). Off the Carolinas juveniles have occurred very infrequently in about 5 fathoms (11 m).

Age and growth data on Carolina fishes have not yet been analyzed; however, the literature provides some information from the Gulf. Red snapper (in the Gulf of Mexico) reportedly attain a length of about 8 inches (200 mm) after 1 year of life, and grow about 2.5 to 4.0 inches (62-100 mm) per year for the next several years. The species attains lengths of 40 inches (1 m) or more and a weight of 35-40 pounds (16-18 kg).

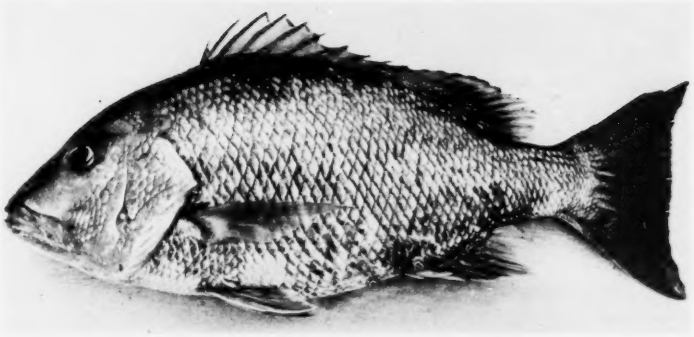

Figure 1.—Adult red snapper, *Lutjanus campechanus*, Onslow Bay, N.C., approximately 13 pounds and 28 inches (total length).

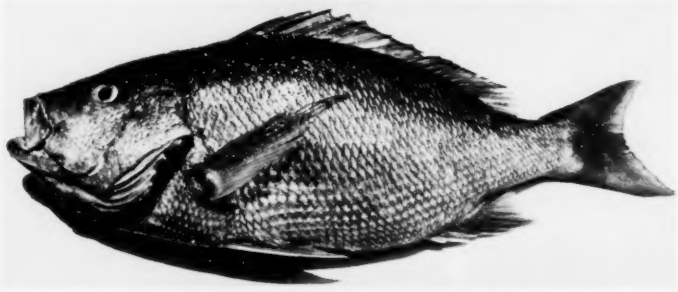

Figure 2.—Adult silk snapper, *Lutjanus vivanus*, Onslow Bay, N.C., approximately 11 pounds and 26 inches (total length).

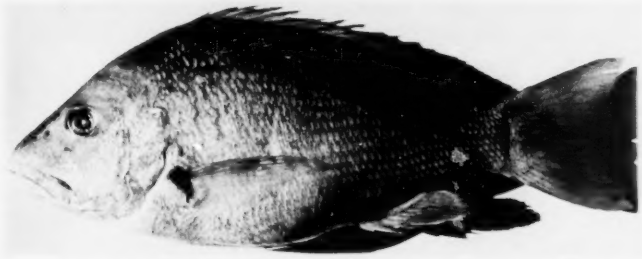

Figure 3.—Adult blackfin snapper, *Lutjanus buccanella*, Onslow Bay, N.C., approximately 9 pounds and 24 inches (total length).

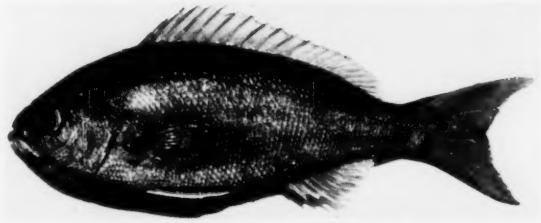

Figure 4.—Adult vermilion snapper, *Rhomboplites aurorubens*, Onslow Bay, N.C., approximately 2 pounds and 16 inches (total length).

SILK SNAPPER

The silk snapper is known as yelloweye from the Carolinas and as the day snapper, day red snapper, long-fin snapper, pargo de la alto, and West Indian snapper elsewhere. It makes an important contribution to the Carolina headboat catch and appears as frequently as the true red snapper. The yelloweye easily separates the silk snapper from its close relatives, the

red snapper and the blackfin snapper, each of which possesses a red iris. It is easily distinguished from the vermilion snapper which is characterized by a more streamlined body shape and deeply forked tail.

The silk snapper commonly occurs in the western Atlantic from northern South America to North Carolina. It is well distributed in the Gulf of Mexico and Caribbean and is also found in Bermuda waters. The silk snapper generally occurs in waters somewhat deeper than either the red snapper or the vermilion snapper. Off Bermuda the species is common in 70 to 85 fathoms (128-156 m) during the day but shallower at night. In the Bahamas it is caught at the edge of the Gulf Stream in waters 83 to 133 fathoms (151-243 m) deep. Headboat catch records indicate that ideal habitat off the Carolinas is rough bottom at 30 to 70 fathoms (55-128 m). Experimental fishing aboard the NMFS vessel *Onslow Bay* substantiates this with best catches at 40 to 55 fathoms (75-100 m). An earlier report states that the species occurs in water ranging from 30 to 120 fathoms (55-219 m) off North Carolina, and exploratory trawling in the 1960's off North Carolina revealed concentrations at the shelf edge at 30 to 50 fathoms (55-91 m). Silk snapper may be taken over both rough and relatively smooth bottom. Researchers in the Gulf report that silk snapper are the only species of *Lutjanus* caught on mud bottom in deep water. There they are commonly found on smooth, flat bottom above the shelf break at 40 fathoms (73 m).

The silk snapper is caught on hook and line by recreational and commercial fishermen throughout the southeastern United States, Gulf of Mexico, and Caribbean. Fish and squid are preferred baits, generally fished in waters 30 to 60 fathoms (55-110 m) deep. Although they attain a length of 3 feet (900 mm) and a weight of 40 pounds (17 kg), the average silk snapper caught off the Carolinas weighs between 10 and 11 pounds (4.5-5 kg) and is approximately 26 inches (660 mm) long. Individuals in the 15- to 25-pound (7-11 kg) range are fairly common. Silk snapper can be caught year-round off North Carolina and South Carolina.

Like other lutjanids, the silk snapper feeds on a variety of fishes and invertebrates. Cursory inspection of stomach contents from fish collected in North Carolina waters revealed fish, crustaceans, and mollusks in the diet. Silk snapper collected off the Virgin Islands feed primarily on fish, shrimp, and crabs.

Spawning occurs from the late spring through summer. Earlier work off North Carolina suggests that silk snapper spawn from late May to late June in deep water. Spent females have been collected as early as the first week of June. Observations made from our research indicate the silk snapper spawns throughout the summer in North Carolina waters. Ripe females were collected in June, July, and August from 1972 to 1974. The smallest individuals indicating reproductive development were a 9.4-inch (240 mm) female and a 10.6-inch (270 mm) male.

No information is available on age, growth, and mortality. This phase of the life history is currently under investigation.

BLACKFIN SNAPPER

The blackfin snapper can be distinguished from all other snappers by the jet-black base and axil of the pectoral fins and the absence of a black spot below the anterior part of the soft dorsal fin.

Blackfin snapper are recorded from North Carolina, Bermuda, and the Gulf of Mexico through the Antilles to northeast Brazil. Their usual habitats are the Continental Shelf edge or live-bottom areas in depths from 5 to 120 fathoms (9-219 m), though most occur below the shelf edge from 45 to 80 fathoms (82-146 m).

Exploratory trawling in the 1960's revealed blackfins to be rare off the coast of the southeastern United States and only seven have been reported from headboat catches in North Carolina and South Carolina between May 1972 and June 1975. However, blackfins are rarely recognized by headboat crews, and are probably more numerous than is apparent.

The blackfin is a medium-sized snapper; the few individuals sampled by the authors averaged 9.2 pounds (4.2 kg) and 24.7 inches (627 mm). Very large (20-30 pounds; 9-14 kg) blackfin have been seen in commercial catches made near Cape Hatteras. Length and weight data for specimens from the Virgin Islands substantiate the medium size range of the species compared with the other two lutjanids discussed previously. The blackfin snapper ranged from 7.1 to 21.2 inches (180-540 mm) fork length with most of the specimens in the 12.2- to 17.7-inch (310-450 mm) range. A study 4 years later in the same area produced similar results. Forty-two percent of the fish examined were between 15.7 and 19.3 inches (400-490 mm) fork length.

Like most lutjanids, the blackfin is a bottom-foraging species. Fish examined from the Caribbean fed primarily on isopods and fish. Other food items were shrimp, spiny lobster, crabs, octopus, and squid.

No information is available on the reproductive biology of the blackfin snapper from the Carolinas. Ripe fish were taken from oceanic banks near Jamaica in all seasons, but peak spawning reportedly occurs in April, and September to October. Researchers believe peak spawning occurs in April. Blackfin were found to be sexually mature at standard lengths of 12-16 inches (300-400 mm).

VERMILION SNAPPER

The vermilion snapper is the most frequently occurring snapper along the coasts of North and South Carolina. The species is also known as beeliner, chubhead, California red, mingo snapper, night snapper, mutton snapper, and bastard snapper. In Spanish, it is the cunaro (Venezuela) or the cagon de lo algo (Cuba).

The species is one of the smaller members of the family, attaining a maximum size of about 24 inches (610 mm) and just over 6 pounds (2.7 kg). The body is vermilion above and paler below with faint darker lines extending forward and down from the dorsal fin base. Below the lateral line there are narrow yellow streaks, some longitudinal, others oblique. The dorsal fin is rosy with a yellow margin. The pectoral fin is yellowish also, but the anal fin is pale basally, becoming rosy distally. The ventral fins are rosy and the caudal fin is vermilion, often with a faint black margin. Among Atlantic snappers, the streamlined body form and deeply forked caudal fin is shared only with the yellowtail snapper (*Ocy-*

urus chrysurus). However, they are easily distinguishable on a basis of coloration. The yellowtail possesses a distinct yellow mid-lateral stripe which includes most of the caudal peduncle and all of the caudal fin. Also, adult yellowtail are not common north of Florida.

The vermilion is distributed from the Carolinas and Bermuda through the Gulf of Mexico and West Indies to southeastern Brazil. They occur in offshore waters of about 50 fathoms (91 m) and are normally associated with broken rock and reef-type substrate. They are abundant in deep waters (50 fathoms; 91 m) off northern Florida in both the Atlantic and Gulf of Mexico. Along the Carolina coast they are abundant over rough bottom at and near the Continental Shelf break. In southern Raleigh Bay and northern Onslow Bay, N.C., their occurrence is concentrated at depths from 35 to 70 fathoms (64-128 m). They are less abundant on inshore scattered rock and reef outcroppings where adults have been seen collected as shallow as 14 fathoms (26 m). Farther south, in southern Onslow Bay, N.C., and Long Bay, N.C. and S.C., hard bottom areas are more scattered over the Continental Shelf. Here, vermilion snapper appear more abundant than in the north, frequently occurring in 18 to 35 fathoms (33-64 m). Juveniles have been observed on artificial reefs in 10 fathoms (18 m).

The vermilion snapper is, by a vast margin, the most frequently angled snapper of the Carolinas. In 1972 and 1973 North Carolina and South Carolina headboats landed 80,844 and 83,640 vermilion snapper as compared to 2,187 and 3,982 for red, silk, and blackfin snappers combined. In 1972 the vermilion ranked third behind red porgy, *Pagrus pagrus*, and white grunt, *Haemulon plumeri*, as the most frequently caught species. In 1973 vermilion snapper eclipsed the white grunt and became second in number. In 1972 the average weight of fish caught inshore (14-30 fathoms; 25-55 m) was 1.8 pounds (0.82 kg) as contrasted with 2.87 pounds (1.2 kg) for those caught offshore (30-70 fathoms; 55-128 m). In the North and South Carolina recreational fishery, vermilion snapper are successfully caught using either squid or fish as bait, although they seem to prefer squid.

In contrast to previously discussed fish, vermilion snapper are foragers in the water column. Their diet consists of various marine larval forms (e.g., zoea, mysis, phyllosoma, and postlarval shrimp), small adult crustacea (e.g., copepods, amphipods, euphausids, and decapod shrimps), small squid, pelagic gastropods, small fishes, and polychaetes. A diet of distinctly pelagic species with streamlined shape indicates a more pelagic existence than exhibited by other members of the family.

Our studies have shown the vermilion snapper to spawn from late April or May through September. Most adult females appear to reproduce first in their fourth season at a total length of about 13.8-15.7 inches (350-400 mm). Females produce large numbers of small pelagic eggs. The smallest mature females may produce about 150,000 eggs while the largest spawn about 1.5 million per season.

Determination of ages from annual rings on otoliths indicate the species to be relatively slow growing. The largest fish, just over 23 inches (600 mm) total length, are about 10 years old. Although males and females appear to grow at equal rates, females live longer. We have seen no males older than 8 years.

Vermilion snapper are apparently not migratory. However, larger and older fish do occur more frequently offshore (30-70 fathoms; 55-128 m) which could indicate offshore movement by larger adults to preferred habitat. They are always associated with rock or reef substrate where they probably remain in a moderately restricted area of perhaps several square miles. Schools or aggregations are strongly indicated in that solitary individuals are seldom caught. Recording depth-finder traces show moderate size aggregations of what we believe are vermilion snapper extending up several (1-4) fathoms above the substrate.

There are four species of red snappers which account for significant portions of the catch of North Carolina and South Carolina headboats. The vermilion snapper is the most frequently landed while the true red, silk, and blackfin snappers appear less often. With the exception of the vermilion snapper, the life histories of these species off the Carolinas are not well known but are currently under investigation by the National Marine Fisheries Service Center at Beaufort, N.C.

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MFR PAPER 1230

Finding Fish With Satellites

ANDREW J. KEMMERER and JOHNNY A. BUTLER

ABSTRACT—The LANDSAT (Land Satellite) Investigation began in April 1975 to determine if satellites can be used to help fishermen find fish. The cooperative government, industry, and academic study uses multispectral scanners in LANDSAT satellites to measure certain ocean features for locating fishing areas for menhaden and thread herring. Two study areas were selected for field operations during the 1975 menhaden fishing season; the eastern portion of Mississippi Sound and a 5,200 km² area off the Louisiana coast. Aircraft sensors, fishing vessels, spotter pilots, research vessels, and offshore oil platforms were used to collect supplementary and corroborative data on chlorophyll, surface water temperature, salinity, color, turbidity, and fish school location and size. Data analyses so far indicate that water color and turbidity significantly correlate with the distribution of menhaden. Surface temperature and salinity do not appear to be significant factors. The effect of chlorophyll is unclear. Classification algorithms were developed for satellite data which divide the study areas into high and low probability fishing zones. Tests performed on these algorithms with fish catch location information indicate classification accuracies in excess of 80 percent.

INTRODUCTION

A cooperative U.S. Federal Government, private industry, and academic study is being conducted in the northern Gulf of Mexico. It is called the LANDSAT (Land Satellite) Menhaden and Thread Herring Resources Investigation. Its purpose is to demonstrate the potential of satellite remote sensing as an aid in locating commercially harvestable stocks of menhaden and thread herring. The study uses the talents and capabilities of fishermen, oceanographers, engineers, fishery biologists, data managers, and remote sensing specialists, all with different objectives, but when taken together satisfying the same purpose.

Kemmerer

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In a study of this type, especially one involving participants from many different occupations, there are many questions to be answered. These questions are difficult to answer because they deal with subjects not directly related to any single discipline. Answers to 20 of the more commonly asked questions are given in the following section.

QUESTIONS AND ANSWERS

1. Q. What is LANDSAT?
   A. LANDSAT consists of two identical satellites, LANDSAT I, and LANDSAT II, launched in 1972 and 1975, respectively. The two satellites are platforms for remote sensors, the one used in this study is a multispecial scanner. It measures color as light intensity in four regions of the light spectrum. Both are experimental satellites that are being used by scientists to find out if satellites can help them in areas such as forestry, agriculture, water resources, oceanography, etc. These satellites orbit the earth at 917 km and provide repeat coverage of specific points every 18 days. Their orbits are synchronized so that a specific area is covered every 9 days.
2. Q. What is the purpose of the LANDSAT Menhaden and Thread Herring Investigation?
   A. It is an attempt to find out if satellites can help fishermen find fish. Our assumption is that if satellites can help fishermen find fish then the same capability can help fishery managers better manage fish resources. We are also using the study to develop better techniques for analyzing remotely sensed data (from aircraft and satellites) and to determine how selected parameters in the ocean environment affect fish movements.
3. Q. How can a satellite that looks at the Gulf Coast area only every 18 days help fishermen? Information is needed several times a day!
   A. We agree that LANDSAT satellites probably will not presently aid fishermen directly. However, before an operational satellite system, to benefit fishermen, can be designed and deployed, we must know if such a system is feasible. The LANDSAT satellites should

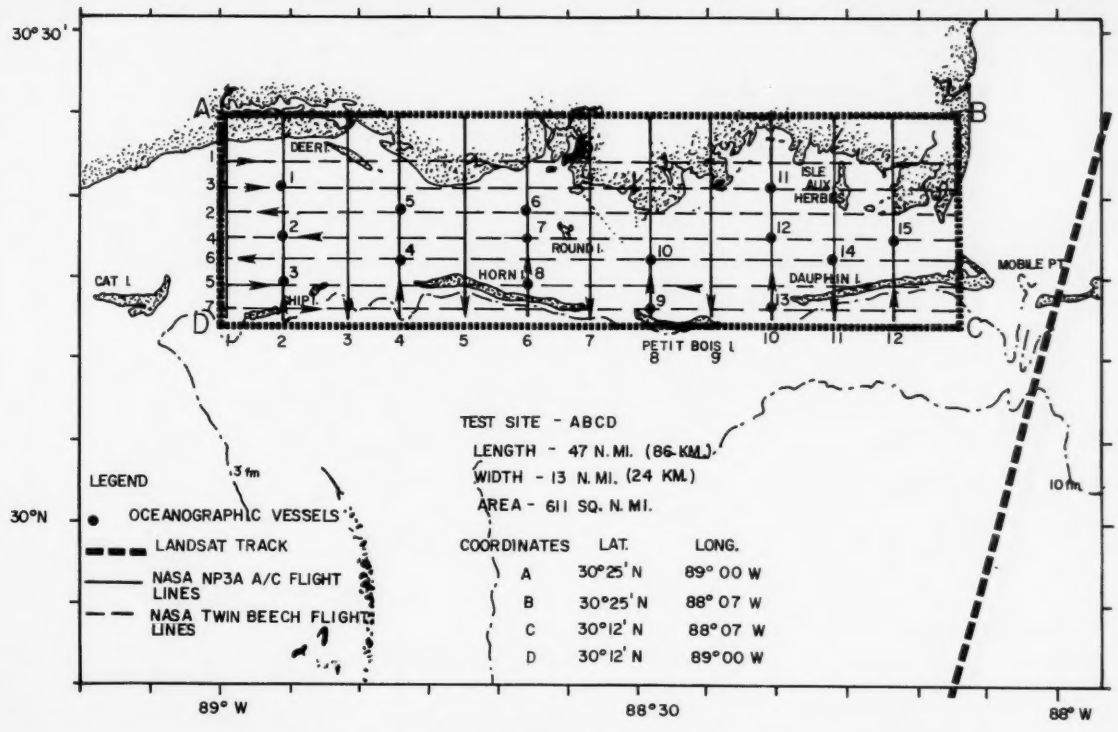


Figure 1.—Mississippi Sound study area.

provide this information. Probably the class of satellites needed for fishery applications is what is known as "geostationary." This means the satellite orbits at the same speed as the earth turns so that its position never varies with respect to a given location on earth. The GOES (Geostationary Operational Environmental Satellite) satellite, already in orbit over the Gulf, does exactly that. It transmits data to earth regarding cloud patterns and movements every 30 minutes.

4. Q. Does LANDSAT see fish?
   A. No, its resolution (ability to detect objects like fish schools) is inadequate. There are no civilian satellites available with adequate resolution to detect most fish schools (e.g., menhaden and thread herring). An object has to be about 80 m in diameter and very contrasting in color before LANDSAT can detect it.
5. Q. If LANDSAT cannot detect fish schools, what good is it?
   A. Even though it cannot detect fish schools directly, it can measure certain ocean features which may affect the distribution of fish. One of the basic assumptions in ecological theory is that all living organisms are influenced by their environment. Fish are no exception. For example, our data suggest that the distribution of menhaden is strongly related to the turbidity of the water. If this is true, it should be possible to predict where menhaden are by monitoring water turbidity. The LANDSAT sensors may be able to do this.
6. Q. Who is involved in the LANDSAT Investigation?
   A. Primary participants are from the menhaden fishing companies (member companies of the National Fish Meal and Oil Association), NASA's Earth Resources Laboratory, and the Fisheries Engineering Laboratory (Southeast Fisheries Center, National Marine Fisheries Service). Throughout the investigation, and especially during the 1975 fishing season, we worked closely with fleet managers, vessel captains, and spotter pilots from the five menhaden companies in the northern Gulf of Mexico. In addition, each company appointed one or more people called "cooperators" to review, advise, and coordinate plans, procedures, and results. Other participants include NASA's Goddard Space Flight Center (they funded most of the investigation), the Johnson Space Center, and the National Space Technology Laboratories; NOAA's National Environmental Satellite Service, the National Weather Service, and the Atlantic Oceanographic and Meteorological Laboratory; the U.S. Geological Survey; the U.S. Coast Guard; Nicholls State

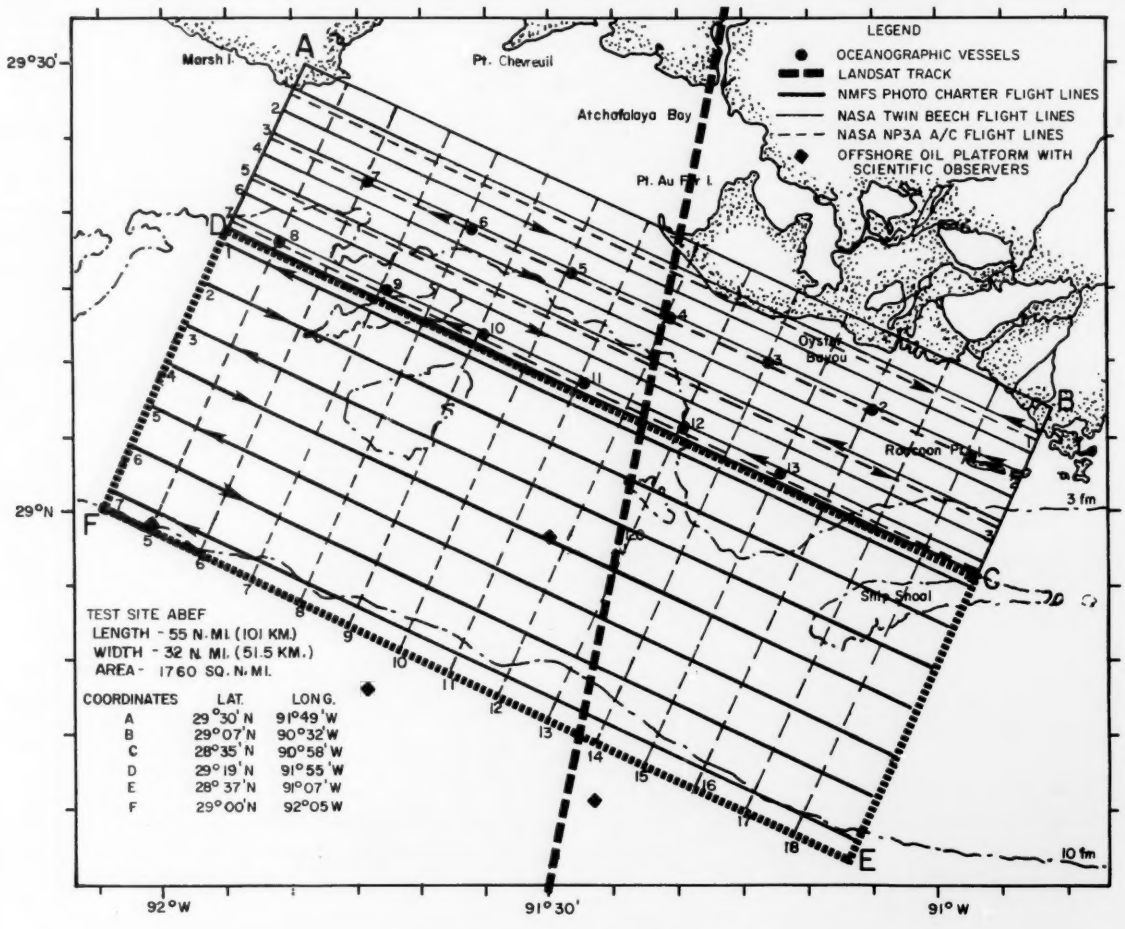


Figure 2.—Louisiana study area.

University; and four offshore oil companies.

7. Q. When did the LANDSAT Investigation begin, and when will it be completed?
   A. Officially, the investigation did not begin until 29 April 1975. Unofficially, however, we began developing plans for it in the fall of 1974. The field phase, i.e., the phase where information was collected, was conducted during the 1975 menhaden fishing season (April-September). We are now in the analysis phase which will continue until the final report is prepared in February 1977.
8. Q. Why will it take so long to finish the investigation?
   A. Primarily because the remotely sensed data will take many computer hours to process and analyze. The LANDSAT Investigation is an experiment in the truest sense of the word. A tremendous amount of data was collected and all of these data have to be processed and analyzed. Frequently, an analytical strategy selected for a particular set of data does not work well and something else has to be used. There are many analytical "blind alleys" that have to be explored. Some lead to something of value, others do not.
9. Q. Where was the LANDSAT Investigation conducted and why?
   A. Two study areas were used: the eastern portion of the Mississippi Sound and a 5,300 km^2 area off the Louisiana Coast (Figs. 1 and 2). These study areas were selected because both support sizable populations of menhaden, and thread herring are known to occur off Louisiana at about the 10-fathom curve. Two study areas were used instead of just one because we wanted to be able to test the results from one against the other so that ultimately the results might be applied to the entire northern Gulf of Mexico.
10. Q. Why were menhaden and thread herring chosen as target fish species?
    A. Both are generally found near the surface of the water and thus are likely to be affected by ocean features which can be

measured with aerospace remote sensors. In addition, because of the active menhaden fishery, we felt that we could get good information on fish distribution and abundance. Without these fishing data, the investigation would have been worthless. We hope by showing that satellite remote sensing will work for menhaden that enough interest will be stimulated in federal, state, and private industry groups to apply this technology to other species. Thread herring are a secondary target species in the investigation and we hope information obtained for menhaden can be applied to them. This might aid in expanding the thread herring fishery.

11. Q. What kind of information was collected during the 1975 menhaden fishing season?

    A. We collected data on ocean features measurable from aerospace platforms, from fishermen, and from aircraft spotter pilots. These were: chlorophyll (measure of the amount of algae in the water); surface water temperature; salinity (amount of salt in the water); water color; turbidity (amount of silt and other material in the water); and location and size of fish schools.

12. Q. How was information collected?

    A. We relied on vessel captains and spotter pilots for the fishing data. Scientific observers, on board selected fishing vessels, collected water samples at the site of menhaden and thread herring catches. Two NASA remote sensing aircraft were used to measure water temperature and salinity, two features LANDSAT does not measure. One NASA aircraft was also equipped with a similar remote sensor employed by LANDSAT. This provided coverage when cloud cover or other reasons prevented coverage by LANDSAT. Also, three oceanographic research vessels were used in both study areas and scientific observers collected water samples from four offshore oil platforms in the Louisiana study area. Figures 1 and 2 show flight lines of the remote sensing aircraft, locations of water sample stations for the research vessels, the flight track of LANDSAT, and the oil platform locations in the Louisiana area. All sampling from surface vessels and oil platforms followed identical collection procedures so that the data could be integrated.

13. Q. Was this information collected continually throughout the fishing season?

    A. No. Three major and four minor field operations were conducted in each study area (Figs. 3 and 4). These operations took place the day before, the day of, and the day after LANDSAT coverage. Major field operations are referred to as "Main Missions" and the minor ones as "Supplementary Missions." The main missions were designed to provide all data necessary for developing and analyzing computer models; data from the supplementary missions are used to serve as checks on main mission data analysis.

14. Q. What does LANDSAT measure?

    A. It measures water color, i.e., the amount of light energy radiated from the water. The multispectral scanner aboard LANDSAT measures light intensity in four spectral bands

PLATFORM	MISSION / DATE	MAIN MAY 2	MAIN MAY 20	SUPPLEMENTARY JUN 25	ABORTED MAIN[1] JUL 31	SUPPLEMENTARY AUG 18	MAIN[2] SEP 5	SUPPLEMENTARY SEP 23
FISHING VESSELS		X	X	X	X	X	X	X
SPOTTER AIRCRAFT		X	X	X	X	X	X	X
FISHING VESSEL OBSERVERS		X	X		X		X	
RESEARCH VESSELS		X	X				X	
ERL AIRCRAFT		X	X					
NP3A AIRCRAFT		X	X				X	
LANDSAT II		X	X	X	X	X	X	X

1 Mission aborted due to inclement weather and unavailability of NP3A.

2 ERL Aircraft unable to complete mission due to inclement weather and mechanical failure.

Figure 3.—Summary of Mississippi Sound missions, 1975.

PLATFORM	MISSION / DATE	MAIN APR 25	MAIN MAY 13	SUPPLEMENTARY JUN 18	ABORTED MAIN[1] JUL 24	SUPPLEMENTARY AUG 11	RESCHEDULED MAIN AUG 20	SUPPLEMENTARY AUG 29	SUPPLEMENTARY SEP 16
FISHING VESSELS		X	X	X	X	X	X	X	X
SPOTTER AIRCRAFT		X	X	X	X	X	X	X	X
FISHING VESSEL OBSERVERS		X	X		X		X		
RESEARCH VESSELS		X	X				X		
OIL PLATFORMS		X	X				X		
ERL AIRCRAFT		X	X				X		
NP3A AIRCRAFT		X	X				X		
PHOTOGRAPHIC AIRCRAFT		X	X				X		
LANDSAT I		X	X	X	X	X	X[2]	X	X

1 Mission aborted due to mechanical failure reported aboard LANDSAT I.

2 LANDSAT II.

Figure 4.—Summary of Louisiana missions, 1975.

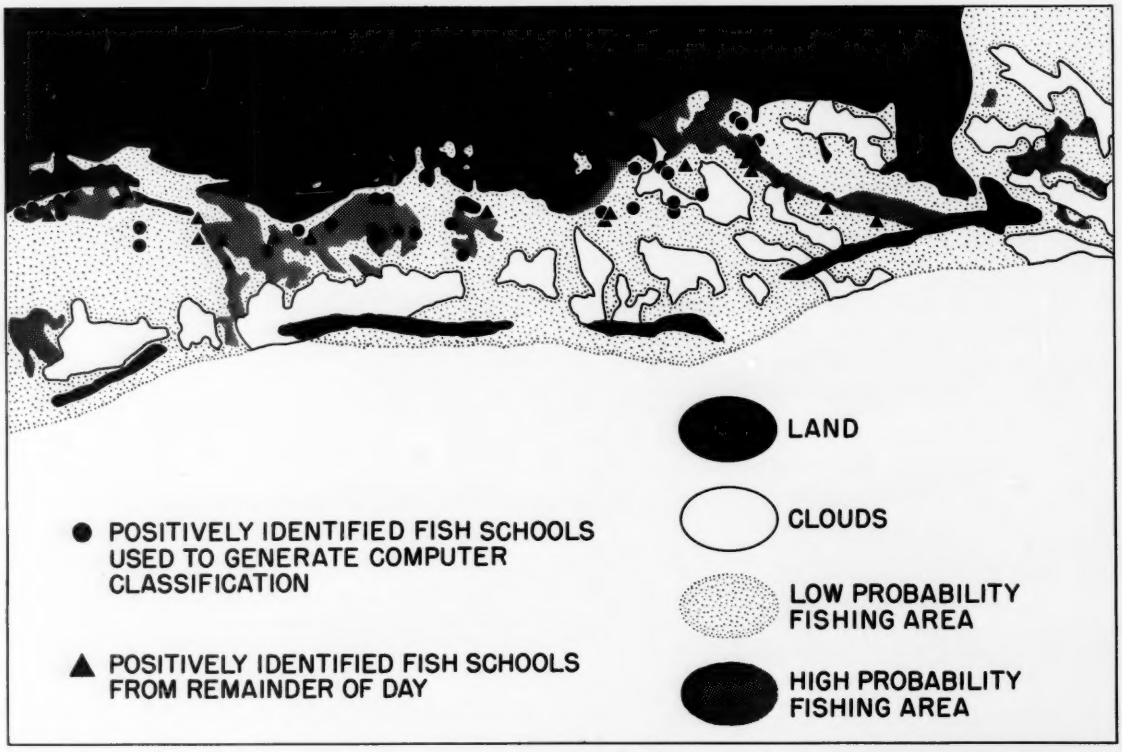

LAND
CLOUDS
LOW PROBABILITY FISHING AREA
HIGH PROBABILITY FISHING AREA
POSITIVELY IDENTIFIED FISH SCHOOLS USED TO GENERATE COMPUTER CLASSIFICATION
POSITIVELY IDENTIFIED FISH SCHOOLS FROM REMAINDER OF DAY

Figure 5.—Computer classification of LANDSAT data into high and low probability fishing areas (data from 20 May 1975).

(green, red, infrared-1, and infrared-2). It views the earth as a series of small squares, 79 m on a side, and records the amount of light radiated from each square in the four spectral bands. From these color measurements, we hope to be able to infer water chlorophyll, turbidity, and possibly fish distribution. Four images (photographs) are produced from LANDSAT corresponding to the four spectral bands. Images are formed by putting the 79 m squares together and representing the quantity of radiant energy in each square as a shade of gray. The lighter the square the greater the radiated energy.

15. Q. What ocean features affect the distribution of menhaden and thread herring?

A. Although the analyses are still not complete, it appears that water color and turbidity correlate strongly with menhaden distribution (menhaden seem to prefer turbid waters). For example, 1.1 m was the average secchi disc visibility depth (measurement of turbidity) where menhaden were caught in both the Mississippi Sound and the Louisiana test sites. The same was found to be true for a 1972 menhaden experiment conducted in the Mississippi Sound where similar measurements were made. Water temperature and salinity do not appear to have much of an effect on menhaden distribution within the range of values measured during the study. The influence of chlorophyll is still unclear. Our analysis of the thread herring data is too incomplete for conclusions.

16. Q. Does LANDSAT measure anything that can be used to find fish?

A. Yes. We compared locations of fish catches and spotter pilot observations to LANDSAT data and there appears to be a relationship between these locations and water color as viewed from space. Figure 5 shows how LANDSAT data were used to develop a chart of good and bad fishing areas in the eastern portion of the Mississippi Sound. The data were computer classified into four areas: land, clouds, high probability fishing, and low probability fishing. The black dots are locations of menhaden catches and spotter pilot observations within 2 hours of satellite passage; the black triangles represent similar observations throughout the remainder of the day. Except for the cloudy area near the center of the figure, the results of the classification technique appear to be reasonably accurate. The misclassifications in the center

portion were probably due to cloud contamination of the satellite data. The computer algorithm used to process the data does not distinguish between wispy clouds and turbid water.

17. Q. Will the LANDSAT classification procedure work every time?
    A. We do not know with any degree of assurance. That is why we are still analyzing data. We want to know if this classification procedure will work most if not all of the time. We have, however, successfully classified data from two other missions into high and low probability fishing areas.
18. Q. What about the geostationary satellite GOES? Does it have any potential for finding fish?
    A. No one knows. We hope to be able to answer this question as part of the LANDSAT Investigation. We do know, however, that its predictions of fish distribution will not be as good as those computed from LANDSAT data, primarily because of its limited sensor capability. The sensor aboard GOES is similar to LANDSAT except that it measures radiated energy in two channels instead of four and with much less spatial resolution. The two channels include one in the visible portion of the spectrum and one in the infrared, or temperature region. Spatial resolution for the first is about 0.8 km (compared to 79 m for LANDSAT) and about 6.4 km for temperature. The ability of the sensor to measure subtle differences in water color is also probably less than for LANDSAT.
19. Q. Are there any other proposed satellites that might be used for fisheries?
    A. Yes, a satellite named Nimbus-G is scheduled for launch in 1978. It will have a color sensor with better color resolution than LANDSAT. This satellite will provide repeat coverage for most areas every 3 days. The Coastal Zone Color Scanner (CZCS) scheduled for launch aboard Nimbus-G is the first visible region imaging system designed specially for oceanographic purposes. It will have six radiance channels ranging from 433 to 12,500 nm add a sun synchronus orbit at an altitude of 955 km. Exact repeat coverage will be provided every 6 days. Swathwidth will be about 1,200 km with a spatial resolution of about 800 m.
20. Q. How can I get more information about the LANDSAT Investigation?
    A. Write or call either of the following people:

Andrew J. Kemmerer
National Space Technology Laboratories
National Marine Fisheries Service, NOAA
Bay St. Louis, MS 39520
Telephone (601) 688-3650

Johnny A. Butler
National Marine Fisheries Service, NOAA
Post Office Drawer 1207
Pascagoula, MS 39567
Telephone (601) 762-4591

MFR Paper 1230. From Marine Fisheries Review, *Vol. 39, No. 1, January 1977. Copies of this paper, in limited numbers, are available from D825, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235. Copies of* Marine Fisheries Review *are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 for $1.10 each.*

National Marine Fisheries Service Reorganizes

Reorganization of the National Marine Fisheries Service (NMFS) was announced last fall by then-secretary of Commerce Elliott L. Richardson. Under the Commerce Department's National Oceanic and Atmospheric Administration (NOAA), the Service has realigned its organization and functions in keeping with new and expanded responsibilities in fisheries management under the Fishery Conservation and Management Act of 1976.

The reorganization provides a single focal point for policy development and managerial guidance at headquarters level, emphasizes long-range planning and program evaluation, consolidates the management and planning of fisheries research and utilization functions, delegates more authority and operational responsibility to units in the field, and streamlines the organization of headquarters staff units.

A new position of Associate Director, who will execute policy decisions of the Director and allocate Service resources, has been established.

Four new staff offices have been organized within the Washington, D.C., headquarters: the Office of Scientific and Technical Services, the Office of Fisheries Development, the Office of Policy Development and Long-Range Planning, and the Office of Marine Recreational Fisheries. Three offices have Directors for Resource Research, Resource Utilization, and Resource Management.

Four offices will remain basically unchanged: the Office of International Fisheries; the Office of Executive and Administrative Support; the Office of Program Planning, Budget, and Evaluation; and the Office of Fisheries Management.

The Office of Scientific and Technical Services assists the Director with environmental protection, the Columbia River Program, environmental impact statements, aquaculture and other research, resource assessment, and with integration of programs.

The Office of Fisheries Development provides staff advice and review at the national level on financial assistance programs, harvesting and marketing technology, regional fisheries development programs, foreign trade, voluntary inspection and grading programs, and on product standards for seafoods.

The Office of Policy Development and Long-Range Planning reviews, evaluates, and coordinates current policies and programs; develops studies of new theory, techniques, and procedures to achieve fisheries resource quotas which will protect the stocks; and predicts the impact of complex, multi-species fisheries decisions.

The Office of Marine Recreational Fisheries coordinates the planning and development of a diversified program in marine recreational fisheries and relates with other governmental, state, and private organizations.

Seven existing fisheries research centers and three existing utilization research centers have been consolidated into four centers responsible for both biological/environmental research and fisheries utilization research. This change involves a decentralization of authority and a consolidation of management responsibility for NMFS research.

No fisheries laboratories will be closed or relocated as a result of the reorganization, but all research units will report directly to one of the four research centers in the field instead of to Washington headquarters.

Additionally, research centers now have primary responsibility for the conduct of socio-economic research required for the development of fisheries management plans under the provisions of the Fishery Conservation and Management Act of 1976. The four centers are also responsible for providing scientific research support to the Regional Fishery Management Councils established by the Act.

The four centers and their component units are:

NORTHEAST CENTER (WOODS HOLE, MASS.)
- Woods Hole Laboratory
  Woods Hole, Mass.
- Narragansett Laboratory
  Narragansett, R. I.
- Gloucester Laboratory
  Gloucester, Mass.
- Highlands Laboratory
  Highlands, N.J.
- Milford Laboratory
  Milford, Conn.
- Oxford Laboratory
  Oxford, Md.
- National Systematics Laboratory
  Washington, D.C.
- Atlantic Environmental Group
  Narragansett, R. I.

SOUTHEAST CENTER (MIAMI, FLA.)
- Miami Laboratory
  Miami, Fla.
- Pascagoula Laboratory
  Pascagoula, Miss.
- Galveston Laboratory
  Galveston, Tex.
- Panama City Laboratory
  Panama City, Fla.
- National Fisheries Engineering Laboratory
  Bay St. Louis, Miss.
- Port Aransas Laboratory
  Port Aransas, Tex.
- Beaufort Laboratory
  Beaufort, N.C.
- College Park Laboratory
  College Park, Md.

SOUTHWEST CENTER (LA JOLLA, CALIF.)
- La Jolla Laboratory
  La Jolla, Calif.
- Tiburon Laboratory
  Tiburon, Calif.
- Honolulu Laboratory
  Honolulu, Hawaii
- Pacific Environmental Group
  Monterey, Calif.

NORTHWEST AND ALASKA CENTER (SEATTLE, WASH.)
- Seattle Laboratory
  Seattle, Wash.
- Auke Bay Laboratory
  Auke Bay, Alaska

More decentralization of program direction and control from Washington to the five NMFS Regional Offices (located in Gloucester, Mass.; St. Petersburg, Fla.; Terminal Island, Calif.; Seattle, Wash.; and Juneau, Alaska) will also be achieved. Among the management functions previously performed in Washington that will now be performed by regional offices are enforcement and surveillance, fisheries statistics, and fisheries financial support.

Moreover, new functions stemming from extended jurisdiction will be added to regional responsibilities; administrative and technical support to the Regional Fisheries Management Councils will be provided by the regional offices; and Regional Directors, under the Act, will serve as members of the Councils.

NOAA ANNOUNCES NEW APPOINTMENTS

J. Frank Hebard, an oceanographer with the National Oceanic and Atmospheric Administration (NOAA), has been appointed Director of the Commerce Department agency's Marine Ecosystems Analysis (MESA) program. The MESA program, managed by NOAA's Environmental Research Laboratories, is concerned with the impact of human activities on selected marine ecosystems. Present studies focus on the marine life and environment of the New York Bight and Puget Sound, and on the environmental consequences of deep-ocean mining.

Before assuming his present position, Hebard was chief of NOAA's Marine Environmental Protection Office in Rockville, Md., and also held several posts within the agency's National Marine Fisheries Service. He began his career as a biological oceanographer with Fisheries Service programs in Seattle, Wash., and later at the Auke Bay Biological Laboratory in Alaska.

Donald K. Atwood, a research chemist and oceanographer, has been appointed Director of the new Ocean Chemistry Laboratory in Miami, Fla., by the National Oceanic and Atmospheric Administration (NOAA). The NOAA laboratory, part of the Commerce Department agency's Atlantic Oceanographic and Meteorological Laboratories (of NOAA's Environmental Research Laboratories), studies the origin, identity, movement, and ecological impact of various organic and inorganic pollutants. It also pioneers new techniques for identifying pollutants in samples taken from the marine environment, and develops predictive ocean chemistry models of selected ecosystems.

Atwood has been an associate professor in chemical oceanography for the past seven years, at the University of Puerto Rico's Marine Sciences Department. Prior to that he was a research chemist with Standard Oil of New Jersey's Esso and Humble Production Research segments in Houston, Tex., for nine years.

The National Oceanic and Atmospheric Administration has established an Office of Ocean Engineering, Robert M. White, Administrator of the Commerce Department agency, has announced. It will include the existing NOAA Data Buoy Office, the Office of Manned Undersea Science and Technology, and certain functions of the former National Oceanographic Instrumentation Center. Funded at slightly less than $9 million—all drawn from existing component groups—it will be headed initially by Acting Director Steven N. Anastasion of NOAA's Office of Marine Resources.

Anastasion, who joined NOAA in 1972 after a 30-year career in the U.S. Navy, is Chief, Plans and Program Coordination Office in the Office of Marine Resources, and serves as Executive Secretary of the Interagency Committee on Marine Science and Engineering, and as Chief Scientist for the U.S.-French Cooperation in Oceanography. Additionally, he is U.S. Chairman of the Marine Resources and Engineering Coordination Committee of the U.S.-Japan Natural Resources Agreement.

The new office is considered of sufficient importance that it will report to the Administrator and receive policy guidance from the Associate Administrator for Marine Resources. Not only will it coordinate existing NOAA ocean engineering programs; it will initiate some of its own and will serve as a focus for technology transfer within the entire marine community, working closely with other Federal, academic, and industrial organizations.

A major element of the new office's effort will be an ocean instrumentation program useful not only to NOAA but to the Federal and private marine program. It will include research, development, and the standards, meteorology, and calibration essential to data quality. In developing this national program, NOAA will work closely with the National Bureau of Standards.

Veteran meteorologist and air pollution expert John M. Miller has been named Director of the National Oceanic and Atmospheric Administration observatory on the slopes of Mauna Loa, Hawaii. He succeeds Ronald Fegley who returned to the global monitoring program's headquarters in Boulder, Colo.

The observatory is part of a network maintained by the Commerce Department agency's Geophysical Monitoring for Climatic Change program. Stations in the network make measurements of atmospheric constituents and weather variables at locations far from sources of human pollution—high on Mauna Loa; at American Samoa; Point Barrow, Alaska; and the South Pole—to discern long-term climatic trends. The global monitoring program is operated by the Air Resources Laboratories of NOAA's Environmental Research Laboratories. Miller has served as a research meteorologist at the Air Resources Laboratories in Silver Spring, Md., since April of 1972. During his first year there, he was a Presidential Intern.

Commerce Department Appoints Eight to Marine Fisheries Advisory Committee

Secretary of Commerce Elliot L. Richardson announced eight appointments to the Department's top level Marine Fisheries Advisory Committee late last year. The Committee advises the Secretary on programs carried out by the National Oceanic and Atmospheric Administration.

Topics of concern to the Committee include international fisheries, conservation, aquaculture, biological and environmental research, fisheries technology, certain sections of the Marine Mammal Protection Act of 1972, and advisory services for marine recreational and commercial fisheries.

Members of the Committee are chosen for recognized competence and proven interest in the marine fishery resources of the United States and are appointed by the Secretary for a term of three years. Approximately one-third of the Committee members are replaced each year and are selected to achieve both balanced geographical representation as well as a broad view of the U.S. commercial fishing industry, marine recreational fishing, the academic community, conservation interests, state governments, and the consumer. The new members are listed below.

Edward Chin: Academic representative from Athens, Ga; Director, Marine

Resources Program, and Director, Sea Grant Program at the University of Georgia. Chin has a long history of associations with recognized fisheries organizations, including the former Bureau of Commercial Fisheries. He is acknowledged by his many associates as one of the best informed scientists on marine fisheries in the Gulf of Mexico and the western Atlantic.

E. Charles Fullerton: State fisheries representative from Sacramento, Calif. He has, since 1975, been Director of the California Department of Fish and Game and is a veteran of more than 28 years of service with the department beginning as assistant fish and game warden in 1947. He has also served as advisor to the U.S. delegations to U.S.-USSR fisheries negotiations in Washington, D.C. He is California's designated official to the Pacific Fishery Management Council.

Ronald R. Jensen: Commercial fishing representative from Seattle, Wash., and Chairman of the Board and President, Pan-Alaska Fisheries, Inc. Jensen will also represent Pacific Northwest fishermen who also fish in Alaska waters. He is President of the Alaska King Crab Institute; Past President, Northwest Fisheries Association; and was a member of the Advisory Committee on Bilateral Fish Treaties, USSR, in 1973.

Edward G. McCoy: A State government representative from Morehead City, N.C., and Director, Division of Marine Fisheries, Department of Natural and Economic Resources, State of North Carolina. McCoy holds B.S. and M.S. degrees in Fisheries and Wildlife from North Carolina State University. Prior to his employment by the Division of Marine Resources, he served as a biologist with the Wildlife Resources Commission. He has extensive experience in fisheries research and management. McCoy also serves as North Carolina's designated State official on the south Atlantic Regional Fishery Management Council.

Guy Raymond McMinds: A representative of Indian fisheries from Taholah, Wash., and Director of the Quinault Resource Development Program. McMinds holds a B.S. in Fisheries from the University of Washington. He has served as Fisheries Coordinator for the Small Tribes Organization-Western Washington. From 1970-1976, he was Director, Quinault Department of Natural Resources and Economic Development where he managed tribal fisheries and forestry resources.

Mary DePoe Norris: Consumer representative from Seattle, Wash. Norris has been affiliated with Seattle's power company as their home economist. She is a well-known consumer advocate in the Pacific Northwest and has had a strong interest in cooperative fish promotion programs.

Claude Ver Duin: Commercial fishing representative from Grand Haven, Mich., and Executive Secretary of the Midwest Federated Fisheries Council, Inc., Grand Haven, Mich. Ver Duin publishes a trade magazine, *The Fisherman*, and is an active participant in civic and regional affairs. He has served as Commissioner in the (International) Great Lakes Fishery Commission since 1956 and has wide knowledge of biological and ecological problems of the Great Lakes.

Charles C. Yamamoto: Marine recreational fisheries representative from Honolulu, Hawaii, and President and General Manager of C&E Radio of Hawaii, which has served commercial and pleasure boats in the State of Hawaii for the past 23 years. He is a billfisherman who has participated in many major tournaments in the United States and foreign countries and served as officer in several well-known Hawaii Game Fishing clubs. For the past 30 years, he has been involved in many ways in recreational and commercial fishing.

Other members of the Committee are: Richard B. Allen, a lobster fisherman from Westport, Mass.; Donald E. Bevan, Acting Dean, College of Fisheries, University of Washington, Seattle, Wash.; Frank E. Carlton, Savannah, Ga., President of the National Coalition for Marine Conservation; Ross N. Clouston, President of the Gorton Corporation, Gloucester, Mass.; Edwin J. Gould, New York City, a recreational fisherman who also serves as Deputy U.S. Commissioner on the International Whaling Commission; Dennis A. Grotting, Eureka, Calif., Secretary-Manager of the Fishermen's Marketing Association in Eureka; Frank W. Holas, President, Booth Fisheries Division, Consolidated Foods Corporation, Chicago, Ill.; Edward G. Huffschmidt, a recreational fisherman, Lake Oswego, Oreg.; Joe R. Lee, President, Red Lobster Inns, Orlando, Fla.; Frank T. Moss, New York City, Associate Editor with *Yachting Magazine*, and also on the staff of the National Coalition for Marine Conservation; Julius R. Nelson, New Haven, Conn., President of Long Island Oyster Farms, Inc.; Virgil J. Norton, Professor, Department of Economics, University of Rhode Island, Kingston, R.I.; Elmer E. Rasmuson, Anchorage, Alaska, Chairman of the Board, National Bank of Alaska, and Chairman of the International North Pacific Fisheries Commission; Charles W. Sahlman, President, Sahlman Seafoods, Tampa, Fla.; Oliver A. Schulz, San Francisco, Calif., Manager for Fisheries Relations for the Del Monte Corporation; Jack T. Styron, New Orleans, La., President, Louisiana Menhaden Company; Clement Tillion, Halibut Cove, Homer, Alaska, Alaska State Legislator and commercial salmon fisherman; Robert B. Weedin, Fairbanks, Alaska, a conservation spokesman on the staff of the University of Alaska; and Melvin H. Wilson, Los Angeles, Calif., Vice President and Associate Trust Counsel for the Security Pacific National Bank and a well-known Pacific west coast marine recreational fisherman.

Tax Reform Act Aids Fishermen

The Tax Reform Act of 1976, signed into law 4 October 1976 contains several changes affecting the tax status of United States fishermen, according to the National Oceanic and Atmospheric Administration's National Marine Fisheries Service. The Act increases the benefits available to users of the Capital Construction Fund (CCF) tax-deferral program and increases the number of fishermen eligible to use the program.

The CCF program, administered by the Commerce Department agency, enables fishermen to construct, reconstruct, or, under limited circumstances, acquire fishing vessels with before-tax (rather than after-tax) dollars by allowing them to defer payment of Federal taxes on income from the

operation of their vessels. These Federal taxes, when deferred and used to help pay for a qualified vessel project, amount to an interest-free loan from the Government.

Previously, fishermen using the CCF program were not allowed to claim investment tax credit on that portion of a vessel's cost paid for under the CCF program. The Act provides, however, that a 5 percent investment tax credit may now be claimed even on the portion of a vessel's cost paid for under the CCF program (the regular 10 percent investment tax credit is still available for the portion of a vessel's cost not paid for under the CCF program). This change applies to vessels placed in service during taxable years after 31 December 1975.

Only fishing vessels of at least 5 net tons had previously been eligible for the CCF program. The Act, however, now extends CCF eligibility to all fishing vessels 2 net tons or more.

Under the Act, operators of fishing boats with fewer than 10 crewmen no longer have to withhold taxes from crew pay, or make Social Security contributions, if the crew's pay consists only of a share of the boat's or the fleet's catch. Until now, crewmen on fishing boats were treated as regular employees rather than as self-employed, regardless of how they were paid. However, fishing boat operators employing one or more individuals still are required to comply with certain reporting provisions of the Act.

Another section of the Act clarifies the status of certain fishermen's organizations which may now qualify to receive the lower postal rates enjoyed by tax-exempt agricultural organizations. For further information, call or write the nearest NMFS Regional Financial Assistance Division Office.

Fifth NACOA Report Asks Program Changes

The National Advisory Committee for Oceans and Atmosphere (NACOA), in a wide-ranging report, has advocated significant changes in the nation's energy, marine, weather, and climate programs. Chairman of the 25-member group, charged with reporting to the President and Congress annually on the state of the nation's marine and atmospheric programs, is William J. Hargis, Jr., Director of the Virginia Institute of Marine Sciences.

In a report transmitted to the White House on 28 September by the Secretary of Commerce, NACOA recommended refocusing Federal atmospheric and oceanic planning and operational activities. The major recommendations are numbered below.

1) An ad hoc task force should be established by legislation to formulate a comprehensive marine affairs policy and plan pending development of a continuing coordinating mechanism. NACOA stated that oceanic events are developing more rapidly than are plans to cope with them.

2) The nation should explore and develop offshore oil and gas resources consistent with environmental safety and the need for maintaining strategic reserves; and the process should be reconciled with an economic atmosphere suitable for development.

3) Congress should enact pending legislation for a program of climate watch, forecasting, and research under the coordination of the Secretary of Commerce.

4) The National Oceanic and Atmospheric Administration should receive responsibility for coordinating and managing a coherent Federal program of weather modification research and experimentation.

5) Federal funding for the National Sea Grant program should be increased from $23 million to about $40 million per year over the next 3-5 years, and its legislation should be amended to free earmarked funds from matching criteria; its operations, goals, and priorities should be studied and improved.

NACOA found "too much emphasis on haste" in energy research projects whose payoffs are distant in time, and not enough on near term possibilities. It recommended the establishment in the Energy Research and Development Administration of a Directorate for Oversight of Energy Research (DOER) reporting directly to the Administrator, whose function would be to give the Administrator technical advice on comparisons of alternatives.

The advisory group also termed inadequate Environmental Protection Agency pollution research programs addressed to long-term basic knowledge needs. It asked that longer term basic research receive more attention and that lead agencies be established for this purpose in three areas: the National Institute of Environmental Health Sciences for human health and disease; the National Oceanic and Atmospheric Administration for the atmosphere and oceans; and the Department of the Interior for plant and animal life on land and inland waters, with the Council on Environmental Quality leading a high-level interagency coordinating committee in the effort. NACOA also called attention to "serious deficiencies" in diver-physiology-related research, and in the development of decompression tables, and recommended a $3.5 million program toward faster, safer decompression and toward better understanding of the effects of undersea work.

The panel recommended that the Federal Aviation Administration and the National Weather Service review aviation weather needs and capabilities in the light of technological advance; and update their priorities and agreements. It also recommended that educational standards for training in the use of weather information be improved, with emphasis on the effects of developing weather situations on flight control; that computer programs be used to screen deviating data on airway weather observations; that forecasts be analyzed after the fact; and that rapid weather hazard warnings be available to all pilots in flight.

Under NACOA's legislation, the Secretary of Commerce is required to respond to the report's recommendations. His comments, which reflect the views of all government agencies involved, accompany the NACOA document to the White House and Capitol Hill.

Secretary of Commerce Elliot L. Richardson transmitted general agreement with a great many of NACOA's recommendations, but he and other officials took issue with others.

Stating that the U.S. is "setting the pace" for oceans policies, the Secretary sees the problem as the "lack of a

comprehensive approach to setting ocean policies." He termed "the more traditional modes of cooperation between the Executive and the Congress" preferable to NACOA's suggestion for an ad hoc task force; and pointed out that NACOA itself can, under its charter, undertake long-term advisory planning efforts.

The recommendation concerning offshore oil and gas development drew comment from Interior Secretary, Thomas Kleppe; EPA Administrator, Russell Train; and Secretary Richardson.

Kleppe said it was urgent for the government to encourage industry to get on with exploration drilling at a maximum responsible rate. He also expressed concern with NACOA's reference to maintenance of strategic reserves as susceptible to misinterpretation by those who might read into it endorsement of government oil and gas exploration—which, he said, is not the case.

EPA Administrator, Russell Train, concurring "generally" with Secretary Kleppe, voiced his concern that our present knowledge of marine ecological processes and our present technology is of doubtful adequacy to establish or protect oceanic environmental norms. He said offshore energy development should proceed only with full recognition of the need for obtaining scientific information and technology necessary to assure environmentally sound decisions. Secretary Richardson agreed that it would be useful to separate exploration and development environmental impact assessments.

Concurring in the need to develop a better understanding of climate dynamics the Secretary of Commerce voiced support for recommendations of the Domestic Council Subcommittee on Climate for a National Climate Program as well as for the World Meteorological Organization climatic efforts. In the field of weather modification, the Secretary agreed with NACOA's recommendation that there is a need for more basic research and more attention to its environmental, economic, and social impacts.

Stating that the Sea Grant Program has performed well in its first decade, the Secretary agreed with the Committee that there is a need for further evaluation of the program procedures. He has directed the Administrator of NOAA to review these procedures and make needed revisions to accomplish the objectives set forth by the Committee.

EPA Administrator Train, commenting on NACOA's suggestions for improvement of the agency's research programs, said that his Science Advisory Board, whose members are all outside EPA, soon would evaluate the application of long-term ecological research to the EPA mission.

Commenting on the Committee's expressed concerns over the institutional aspects of long-range research on environmental problems, Secretary Richardson said the passage of the National Science, Engineering, Technology Policy and Priority Acts should produce a review of all the science and technology coordinating mechanisms within the Federal Government. "It is my hope," he said, "that this review would result . . . in a discussion of NACOA's recommendations and means to achieve their thrust."

Responding to NACOA's finding of deficiencies in research related to diver physiology, the Secretary of Defense stated that the Navy would be placing increased emphasis on the subject and that its funding for diving medical research is expected to increase by $3 million over the next three years.

NACOA's comments on weather and air safety were called "timely" by Secretary Richardson, who noted that the recommendations would require substantial new Federal investments in manpower, communications and equipment, and would require careful budgetary review. He cited new efforts such as thunderstorm airport alert tests in the New York, Philadelphia, and Washington, D.C. area, greater emphasis on weather education for pilots and air traffic control specialists, and an experimental program at the Kansas City Air Route Traffic Control Center in Kansas City to provide improved weather communications to pilots in flight.

"A Report to the President and the Congress" is for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, at $2.00 per copy.

Low Oxygen Causes High Surf Clam Losses

Lack of oxygen caused mortality levels of surf clams in a 2,100 square mile section of the New Jersey coast to increase from 10 percent in mid-August to over 50 percent in mid-September, according to Carl J. Sindermann, Director of the National Marine Fisheries Service's Highlands Laboratory at Highlands, N.J. The NMFS is a branch of the National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

The NMFS scientists estimate that 59,000 metric tons of clam meat were lost by 1 October, representing about 5 percent of the total clam resource of the Middle Atlantic Bight (from Cape Cod to Cape Hatteras) and about 25 percent of the offshore clam stocks of New Jersey. The total surf clam resource outside the 3-mile limit along the New Jersey coast was estimated in April to be about 207,000 metric tons of clam meats.

During the same mid-August to mid-September period, an area of low oxygen below the thermocline (less than 2 parts per million) persisted. Higher mortality levels were observed in this low oxygen water, reaching 100 percent of the surf clam population sampled at a number of stations.

Mortalities were also observed in New Jersey's ocean quahog populations, which are usually found in deeper waters than surf clams. In an early August cruise, a low mortality (0.8 percent) was observed at 17 sampling locations. Mortality increased in the September survey to 7.7 percent. In three of the deeper stations sampled during the recent survey, mortality levels reached 40 percent. All mortalities were in water with low oxygen levels (less than 2 parts per million).

Monitoring of shellfish populations and bottom dissolved oxygen was extended from the New Jersey coast to the waters off Long Island in late September. This was considered necessary because of several unconfirmed reports of scallop and clam mortalities. Two cruises by scientists from the Highlands Laboratory during the week of 19 September disclosed low-bottom

dissolved oxygen in the Hudson Shelf Valley out 70 miles from New York City and in a tongue extending eastward to Fire Island. Bottom dissolved oxygen readings eastward of that were above critical levels. Stressed surf clams were found in several samples off Jones Inlet, L.I., but no unusual mortalities had been observed by the end of the month.

The shellfish mortality has been attributed to the low oxygen levels observed below the thermocline. The causes for this condition seemed to be related to decay processes associated with a massive bloom of the dinoflagellate *Caratium tripos* which persisted in the area since March 1976, possibly combined with other large-scale oceanographic phenomena.

Continuing studies found improved oxygen conditions in the New Jersey waters according to the Highlands Laboratory. Carl Sindermann, Laboratory Director, said the recovery of the oxygen in the area may be the result of the expected autumn overturn of the water or the result of a recent storm, or a combination of both.

By mid-October Sindermann announced that "the protracted ecological event, so costly in terms of our living resources and of New Jersey's ocean-oriented economy, is coming to a conclusion. We will, however, continue to monitor the event and its after-effects." The low oxygen condition which persisted in the coastal waters all summer was then restricted to a long narrow band, some 15 miles wide, between 40 and 55 miles offshore. Vessels have been assessing the total impact of low oxygen regions upon the sea scallop, ocean quahog, and surf clam population, as well as the impacts upon the middle Atlantic stocks of bottom-dwelling fish and lobsters.

"While, undoubtedly, many finfish and lobster mortalities occurred at the beginning of the low dissolved oxygen period, it is felt that many escaped and have since avoided the area," said Sindermann. "The major effect of the low oxygen with respect to bottom fish and lobsters may well be economic. For instance, there is every evidence that the spring shoreward migration of offshore lobsters was blocked. New Jersey small-boat lobstermen depend on these migrants to supplement the coastal (indigenous) lobster stocks. Lobster landings in at least two New Jersey counties declined 50 percent or more below last year's catch."

There is also evidence that the normal migrations of summer and winter flounders were disrupted, causing them to swim into areas heavily fished by recreational fishermen, with resulting heavy catches of these species. The effects of the lack of oxygen and the heavy taking of the flounders upon their population were expected to be detected by October groundfish survey cruises.

Oregon Natural Area Dedicated as Nation's First Estuarine Outdoor Laboratory

An area virtually untouched by humans in recent decades, the nation's first estuarine sanctuary, was dedicated in Oregon last fall, Elliot L. Richardson, then Secretary of Commerce announced. The sanctuary was created by the Commerce Department's National Oceanic and Atmospheric Administration (NOAA) at the request of state officials some months ago.

The sanctuary consists of about 4,000 acres of land covering the southern tributary of Coos Bay and steep, tree-covered slopes forming a forest area. A brush-covered island guards its mouth, and a narrow finger of land divides South Slough into two arms. A number of historic sites are in the sanctuary, including a graveyard of early settlers, an abandoned gold mine, and an old country schoolhouse, as well as a prehistoric Indian midden and other Indian sites and trails.

To help establish the sanctuary, the state of Oregon was awarded a total of $1,750,000 from NOAA's Office of Coastal Zone management, and contributed a like amount in state and private matching funds. The money is being spent primarily to buy lands within the sanctuary. Oregon just recently purchased 52 percent of the sanctuary lands, or about 2,200 acres, which allowed NOAA to designate the sanctuary. Settlements on the remaining properties are expected to occur by July 1977.

Robert W. Knecht, NOAA Assistant Administrator for Coastal Zone Management, said "the Oregon sanctuary largely reflects the concern of a variety of local citizens, government agencies, and state resource and planning bodies. Their concern for the protection of this little-known, but important, ecosystem will result in a number of benefits, social as well as scientific. The sanctuary designation will help maintain local water quality and enrich our understanding of the complex problems confronting estuaries which is essential to the development of rational coastal management programs at the state, local, and regional levels." Ultimately, Knecht added, NOAA hopes to establish 18 different estuarine sanctuaries, nationally, "to reflect the major types of estuaries found along our coasts." Dedication of the estuarine "laboratory" took place in the Governor's office in Salem, Oreg., on 27 September.

According to NOAA, the sanctuary will serve as a model for measuring human impacts on similar estuarine areas, while simultaneously preserving the land in its natural, unspoiled state. It will also be used by students and scientists for educational and scientific research, and to provide data vital to the development of coastal zone management programs.

Under the Coastal Zone Management Act of 1972, 33 states and territories are at varying stages of designing programs to achieve optimum use of the coasts for recreation, tourism, conservation, beach homes, industrial development, energy production, and other competing purposes.

The Act allows states to receive four annual grants to develop their programs through assistance from NOAA's Office of Coastal Management. In three years of operating, OCZM has awarded states $33 million for program development, $2 million to the State of Washington to put its approved plan into effect.

Robert Kifer, estuarine sanctuaries coordinator for NOAA, said the Oregon sanctuary will have a special management program. Certain activities, he explained, will be prohibited from the sanctuary, while others will be permitted or controlled.

"As a general rule," Kifer said, "any use that would potentially alter the natural environment will be prohibited in the sanctuary. Although it's not a recreation area, the sanctuary will be

available for use by the general public so long as the levels and kinds of uses do not detract from or alter the natural setting."

Camping, for instance, will be permitted in the sanctuary, but no special facilities (such as roads or campsites) may be constructed. Similarly, oyster harvesting, which is now only accomplished in the South Slough of all of Coos Bay, will continue to be permitted and the area leased for harvesting may be enlarged. Uses permitted to limited degrees include farming, timbering, logging, and the operation of motor vehicles.

The Oregon State Land Board will own and manage the sanctuary, aided by a nine-member team composed of representatives from the Oregon Fish and Wildlife Department, Natural Areas Committee, Department of Environmental Quality, Division of State Lands, University Institute of Marine Biology, and the Coos County Commission. Additionally, a full-time manager will be hired.

Foreign Fishery Developments

Fishery Development Plans Aired by Kenya

In a recent interview with the Nairobi *Daily Nation*, John Mumba, Assistant Director of Fisheries in the Ministry of Tourism and Wildlife, surveyed Government plans for developing Kenya's fishing industry. The principal objectives of the Fisheries Department's long-term program are the modernization of fishing operations and an improvement of marketing techniques.

Since less than 10 percent of the registered vessels engaged in coastal fishing are motorized, Mumba announced that the Fisheries Department would help cooperatives purchase more modern boats through a fishermen's loan program. The shipbuilding industry, owned by local craftsmen, will be advised how to construct more seaworthy craft capable of operating on the high seas. The Fisheries Department has improved traditional fishing gear for use by commercial enterprises. The Department has also promoted the construction of fish-landing depots, slipways, jetties, and boat-repair workshops. In addition, coastal fishermen have benefitted by the establishment of cold storage facilities and ice-making plants.

According to Mumba, the major problem currently facing Kenyan fishermen is the marketing of their catch. Through Government efforts, fishermen's cooperatives have been forme3 along the coast with the goal of eventually replacing the marine produce dealers who currently control the distribution of the catch of coastal fishermen. The new cooperatives have been able to regulate prices for the benefit of the fisherman. A new cooperative, being organized in Mombasa, will join those already established in Lamu, Tana River, Kilifi, Msambweni, Shimoni, and Vanga.

Fisheries Department research programs have been oriented towards solving practical problems facing Kenyan fishermen. More resources, however, are spent on experimental surveys to identify different coastal fish species and locate new fishing grounds. Future development of marine fish and crustacea farming on a commercial scale is planned. While still in the research stage, such a project will be carried out at the new "Mariculture Complex" being built at the Fisheries Department's Mombasa headquarters. Mumba also indicated that plans exist for the construction of a fish cannery with private capital.

According to the NMFS Office of International Fisheries, a subsequent discussion with the Director of the Fisheries Department somewhat muted Mumba's optimistic description of Kenya's commercial fishing potential on the coast. The fish cannery for instance, has received only perfunctory interest so far in the Ministry of Tourism and Wildlife, which has yet to do even a feasibility study for such a venture. Likewise, mechanization of coastal fishing craft has consisted of the purchase of one deep-sea vessel.

The structure of Kenya's fishing industry presents sizable obstacles to the development of large-scale commercial enterprises. Coastal catches accounted for less than 15 percent of total fisheries landings in 1974 and the bulk of the commercial catch is coming from freshwaters such as Lake Victoria and La'te Rudolf (Fig. 1). Kenya's marine fisheries catch has declined from 7.9 metric tons (t) in 1970 to only 3.6 t in 1974 (Table 1). More recent data is not available.

The predominance of artisanal fishermen, using traditional gear, contributes to a heavy labor intensity (the 2,000 registered coastal fishing vessels

Figure 1.—Kenya and neighboring countries.

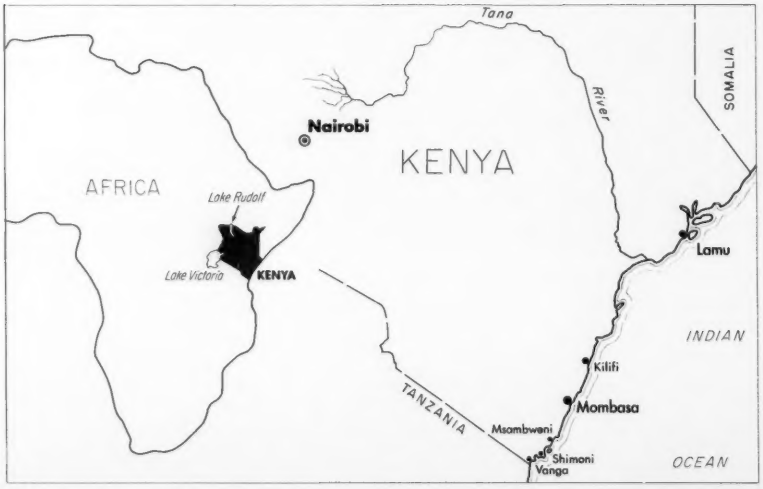


Table 1.—Kenyan fisheries catch, by major fisheries, 1970-1974.

Year	Quantity (metric tons) Freshwater	Marine	Total	Marine as a % of total
1970	25.8	7.9	33.7	23%
1971	21.3	6.9	28.2	24%
1972	22.3	7.7	30.0	26%
1973	25.0	4.0	29.0	14%
1974	25.8	3.6	29.4	12%

Source: FAO "Yearbook of Fishery Statistics," 1974.

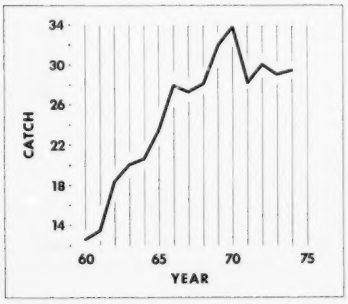


Figure 2.—Kenyan fisheries catch in metric tons, 1960-1974. Source: FAO "Yearbook of Fishery Statistics," 1974.

are owned by over 10,000 persons). The Government has decided against extensive capital investment in this industry as modernization of the industry could result in reduced employment. Development objectives have, instead, focused on improving fish marketing services, expanding existing fish breeding research programs, and promoting fish farming in suitable areas. The overall goal is to increase the fisheries catch, which has actually decreased since 1970 (Fig. 2).

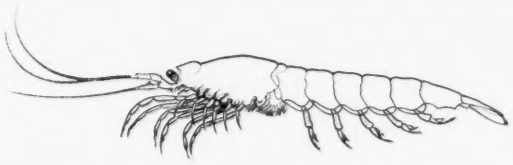
Fishermen's cooperatives, while providing useful extension services, have proved a disappointing experience in many cases. The major problem, according to Government sources, has been the inability to use the cooperatives as a conduit for short-term credits. Weaknesses in cooperative management have made most cooperatives poor credit risks.

Funds extended under the Fishermen's Loan Program will continue to go to only those cooperatives with successful repayment records. Another factor reducing the effectiveness of the cooperative movement in the fishing industry is the resistance of individual fishermen to communal organization. Having failed through exhortation and incentives to expand cooperative membership, Government officials have frequently resorted to fines and boat confiscation.

A sportsman's paradise, Kenya is only beginning to develop the commercial potential of its freshwater and marine fisheries. The country remains a net importer of fish and fish products, primarily fish meal. Per capita domestic consumption of fish, on the other hand, is extremely low. Large-scale processing facilities will be uneconomical unless total production increases substantially—a feat which seems to involve a significant social transformation in addition to financial investment. (Source: U.S. Embassy, Nairobi.)

GERMANS RESEARCH ANTARCTIC KRILL

The two-vessel German krill-research expedition to Antarctic waters returned to the Federal Republic of Germany on 14 June 1976. The research vessel *Walther Herwig* (2,250 GRT) and a Government-chartered stern factory trawler *Weser* (2,176 GRT) traveled 94,000 nautical miles and spent over 8 months on the project, part of the $8 million program to investigate the commercial potential of krill. Scientists of the United Kingdom, France, South Africa, and Argentina participated in the expedition which explored the Scotia Sea, between South Georgia and the South Orkney Islands, the Weddell Sea, and waters south of Africa. The vessels conducted the research in three phases and were based in Montevideo, Uruguay. Each phase (trip) lasted about 3 months.



Krill, *Euphausia superba*, actual size.

The German Government, faced with increasingly restricted catch quotas in areas traditionally fished by the German fishermen and extensions of fishing limits, began the krill program in an effort to investigate a possible future fishery. Antarctic krill stocks have grown to an estimated 200-400 million metric tons (t), as the number of whales which feed extensively on the crustacean has been substantially decreased.

Preliminary results of the expedition reveal that it is possible to locate krill schools, which move in upper water layers to a depth of 300 meters, with specially designed sonar. Large quantities can be caught using pelagic trawl nets (catches of 30 t per hour have been reported, as well as nets torn due to the immense weight of largest catches), though further experiments will be necessary to adjust catches to processing capacity aboard trawlers. A major unresolved problem is the transport of raw frozen krill from the Antarctic to more populous parts of the world, as krill decomposes rapidly during freezing, storing, and thawing processes. If these problems can be resolved, however, fishery biologists estimate that Antarctic krill stocks would permit a commercial harvest of 60 to 100 million t per year. These figures, as well as the biomass estimates above, are highly speculative.

Development of a krill fishery will depend upon consumer acceptance of krill products offered at competitive prices. Toward this end, extensive experiments were directed at producing: 1) krill paste from shelled raw krill by steam treatment; 2) comminuted krill meat from boiled krill; 3) fried krill portions from deep-frozen krill comminute; and 4) a soup-like preparation obtained through an enzymatic process using nonboiled krill. The experiments resulted in products which varied from a firm substance to a soft, malleable paste. The appearance and consistency of the paste resembled that of salami

sausage with a sweetish aroma and a pronounced liver-like taste. The soup-like preparation differed significantly from the first three products. Its color ranged from orange to tomato red and its taste resembled that of crabmeat soup.

In addition to new seafood products for human consumption, the project also explored the possibility of processing krill into edible protein concentrates and animal feed. Preliminary results indicate that the production of krill meal does not appear to pose major problems, but that the production of protein concentrate would require further research.

The relatively high cost of the expedition has evoked criticism from West German fish processors who would have preferred closer-to-home research with more immediate prospects of tangible results. They recommended that more money be appropriated to improve catches from European waters and that research aimed at maximizing the exploitation of known fishery resources be intensified. Nevertheless, the German Government is contemplating the continuation of krill research in the Antarctic as the results have been judged sufficiently encouraging. The proposed program would continue through 1979 and cost approximately US$16 million. Although focused primarily on krill, the program would also extend to other Antarctic fish species. (Source: U.S. Consulate General, Bremen.)

Japan Establishes Panel on Fisheries

Japan's Ministry of Agriculture and Forestry has established a new advisory panel composed of widely respected individuals to discuss the future direction of Japanese fishery policy. While the panel is without power to make official policy, since it has a broad mandate to discuss differing viewpoints and will report directly to the Minister, it may play a pivotal role in the current Japanese domestic debate about the appropriate response to changes in international fishery jurisdictions. The advisory panel includes internationally well-known members from the Fuji Bank and Tokyo University, but has only one representative from the Japanese fishing industry, the Japan Fisheries Association.

The Japanese fisheries trade press was sharply critical of the lack of industry representation on the new panel and also objected that it is a time for action, not more study. The Japanese fishing industry has raised fears about the consequences of a new international system of 200-mile fishery zones which would hurt Japan's distant-water operations and deprive the Japanese nation of an allegedly necessary source of animal protein. While these industry views are well publicized through public relations campaigns in the foreign and domestic press, there is little evidence that public opinion is unified behind the position taken by Japan's distant-water fishing companies. The public is somewhat skeptical of the fishing industry's predictions of disaster, seeing in this some special pleading for vested economic interests.

In choosing the members of the advisory panel, the Japanese Ministry selected representatives of several academic disciplines, from the press, and from Japan's International Cooperation Foundation. The composition of the panel and its broad mandate to hear views of those outside the fishing industry appears to indicate broad questions of future fishery policy, including the appropriate response to extensions of fishery jurisdictions, will be studied. (Source: *Suisan Shuho*.)

According to the NMFS Office of International Fisheries, the decision Japan's Government makes with regard to extensions of fishery jurisdictions will affect current U.N. Law of the Sea negotiations as well as U.S.-Japan bilateral fishery talks and Japanese fishery relations with other countries around the world. A new international fisheries regime will affect different sectors of the diverse Japanese fishing industry in different degrees. While the fishing operations of major Japanese fishing companies may suffer, for example, the importing and marketing operations of the same companies may benefit. A flow of Japanese capital to coastal nations in both developed and developing nations, which desire to expand or revitalize their domestic fishing industries, may be stimulated by these changes. Foreign investment and an international transfer of technology may lead to shifts in producing and trading patterns, to changes in the dietary patterns of Japanese consumers, and in the marketing of overseas fishery products in Japan.

Japan, Peru Sign Fish Cooperation Agreement

Japan and Peru signed a Technical Cooperation Agreement in Tokyo on 7 June 1976, providing for the development of food fish for the domestic Peruvian market. The Agreement details Japanese cooperation in the construction of a fisheries processing center at Callao, near Lima (see map), at a total estimated cost of 900 million yen (US$9 million). This will be the first research center in Peru dedicated solely to fish processing.

Peru will disburse a total of 600 million yen (US$6 million), or approximately 65 percent of the total cost by providing a 40,000 square meter location and a 6,700 square meter building. The Japanese grant, which will be financed through the budget of the Japanese Foreign Ministry through the Japan International Cooperation Agency (JICA), will amount to 300 million yen (US$3 million), or approximately 35 percent of the total cost. This will include pilot plants for freezing, canning, and fish paste processing, laboratory equipment and the assignment of Japanese scientists, engineers, and

other experts. Minoru Okada, former director, Utilization Division, Tokai Regional Fisheries Research Laboratory of Japan Fisheries Agency, has already been assigned to provide technical assistance in building the Center.

The Center will have the following three functions: 1) technological development of fish processing for human consumption; 2) training of Peruvians in fish processing technology; and 3) marketing and distribution surveys. Organizationally, the Center will have four divisions: 1) test processing; 2) scientific research) 3) training; and 4) marketing. The test processing division will have four laboratories (freezing, canning, fish paste, and salted/dried fish) with a possible addition of two laboratories (fish oil and seaweed) in the future.

Two Japanese prefeasibility survey teams were sent to Peru (January and October 1974) to provide technical assistance in planning the construction of the Center. This is one of the projects commemorating 100 years of friendship between Japan and Peru. In April 1975, agreed minutes were signed during a visit by a Japanese feasibility study team to Peru. The domestic economic situation, however, had prevented Peru from signing a formal agreement until recently. Source: U.S. Embassy, Tokyo.)

According to the NMFS Office of International Fisheries, in an effort to increase Peru's production of food fish, the Peruvian Government corporation, Empresa Publica de Servicios Pesqueros (EPSEP) formed a joint venture company, Challwa del Peru, S.A. (CHALLPESA), in December 1973. CHALLPESA is 34 percent owned by EPSEP, and 66 percent by three Japanese fishing companies, Mitsubishi Corporation (33 percent), Taiyo Gyogyo Kabushiki Kaisha (25 percent), and Nihon Hogei Kabushiki Kaisha (8 percent). Experimental fishing was carried out as a result of an agreement between the Peruvian Government and another Japanese joint venture company, Ballenera del Kinkai del Peru.

CHALLPESA has two processing plants; the first is located in the fishing complex at Paita and the second in Callao. The Paita plant processes blocks of hake fillets and hake paste (surimi). The plant is presently supplied by a 200-GRT vessel servicing a number of catcher boats. Plans call for the eventual expansion of the Paita plant to process 120,000 t of hake annually.

In Callao, CHALLPESA will build a cannery with a daily capacity of 2,000 cases of bonito, menhaden, jack mackerel, and club mackerel. In addition, CHALLPESA has purchased the sausage plant formerly operated by the Ballenera de Kinkai company and a cannery formerly owned by a Peruvian subsidiary of Taiyo. The sausage plant has the capacity to produce 20,000 units a day and the cannery can produce 800 cases a day. The plants are supplied by a 700-GRT vessel, *Challwa I*.

TAIWAN'S LOBSTER FISHERY REVIEWED

The lobster industry of Taiwan is catching, processing and marketing two distinct types of lobster; the spiny lobster *Panulirus* sp. and the slipper lobster (*Ibiscus cilatus*).

Taiwan's spiny lobster includes six species: *Panulirus japonicus, P. dasypus, P. penicillortus, P. versicolor, P. ornatus,* and *P. longipes*. Spiny lobsters in Asian waters are found along the eastern coasts of Japan and Taiwan, and off southeast Asian countries. In Taiwan they are found along the eastern and southern coasts from Suao in the north to Luichiu in the southwest and in the Pescadores (Fig. 1). They are caught near the shore on rocky bottom in shallow water.

The spiny lobster is caught mainly by independent divers who also bring in incidental catches of abalone. Small quantities are caught by fishermen aboard powdered 5-gross-ton boats using tangle nets. The catch is kept alive in tanks or cages until it is marketed.

Figure 1.—Taiwan and the Pescadores.

Lobsters are harvested the year-round in Taiwan, but the catches are largest in northern Taiwan from March to October and in southern waters, from October to March. Spiny lobsters are caught within Taiwan's 3-mile fishery zone. No lobster smaller than 20 cm in size may be retained. Annual catches fluctuate considerably. In 1974, a total of 163 metric tons (t) was harvested, more than in most years, but less than in the record year of 1971 (Table 1).

Table 1.—Taiwan's spiny lobster and slipper lobster catches in metric tons, 1965-1974.

Year	Quantity	
	Spiny lobster	Slipper lobster
1965	113	—
1966	115	786
1967	89	957
1968	143	1,372
1969	126	1,877
1970	161	1,918
1971	185	2,103
1972	120	3,709
1973	124	1,968
1974	163	2,199

Source: Ocean Fishery Development Administration, Taiwan, 1975.

Almost the entire spiny lobster catch is consumed in Taiwan, although a nominal amount is shipped to Japan. Japan's import statistics for 1974 show 3 t of live lobster imports from Taiwan. Because the spiny lobster is marketed live, shipping beyond Japanese ports is virtually impossible.

In contrast to the spiny lobster industry, Taiwan's slipper lobster industry is primarily targeted at exporting frozen lobster tails to the United States. The slipper lobster is an incidental catch of Taiwan's trawl fishermen operating in the East and South China Seas.

From 1966 through 1972 the catch of this species (Table 1) continued to increase rapidly each year. In 1972, it almost doubled, but the year after it decreased below the 1971 level. The reasons for these fluctuations are not known.

Immediately after being caught, the

slipper lobsters are frozen whole on board the fishing vessels. Once landed, lobster is either transported in refrigerated trucks to Kaohsiung and Keelung fish markets for public auction, or is taken directly to freezing plants. In the freezing plants, located near Kaohsiung and Keelung, the lobster are partially thawed, headed, deveined, and graded into four classes based on size. The graded lobster tails are frozen, glazed, and packed individually in 5-10 lb boxes, which are then packaged in 50 lb export cartons. The processed tails are inspected by a Taiwanese Government official from the Bureau of Commodity Inspection and Quarantine and are shipped in refrigerated containers with a capacity of 10 to 20 t each, at a temperature of —18°C. The tails are exported by the main seafood freezing plants in Kaohsiung and Keelung, and by several trading companies in Taipei. Members of the Taiwan Frozen Seafood Exporter's Association set minimum prices of frozen lobster meat and tails for export. Exporters obtain tails through public auctions or from their own trawl operations.

Taiwan's Government maintains quality standards for processing and freezing shrimp and lobster issued by the National Bureau of Standards, Ministry of Economic Affairs. (Source: Ocean Fishery Development Administration, Taiwan, 1975.)

The United States imported 917 t of lobster from Taiwan worth $5.8 million in 1975. This was a 17 percent increase in quantity and a 36 percent increase in value over the 1974 totals, which were 805 t and $3.7 million respectively. (Source: *U.S. Import Statistics*, 1974 and 1975.)

GROWTH SEEN FOR TAIWANESE FISHERIES

The annual fisheries catch of Taiwan increased from 16,862 metric tons (t) in 1945 to 770,550 t in 1975, or almost by forty-six times (Fig. 1). The average annual growth rate during these three decades was 10 percent. The Fishery Development Plan, recently announced by the Taiwan Ministry of Economic Affairs, provides for a fisheries catch amounting to 966,000 t by 1981. The average annual growth rate during this 6-year period is forecast at 4.5 percent.

From 1945 to 1973, the fisheries catch increased continuously each year (except for a small decrease in 1949); the average increase during these 28 years was 25,100 t each year. In 1974, however, Taiwan's catch declined below the 1973 level. This was the first decline in Taiwan's fisheries catch in twenty-five years. The decline was caused by reduced high-seas and outer coastal fishing operations, two sectors where a substantial number of vessels remained idle because of high fuel costs, depressed market conditions, and excessive inventories resulting from the record 1973 catch. In the high-seas fisheries, operations were also affected by restrictions on foreign fishing off the coasts of other maritime countries. In 1975, on the other hand, the fisheries catch again increased (by 10.4 percent) and reached 770,500 t, representing an increase of almost 73,000 t over the 1974 catch of 697,725 tons (Table 1).

The large fluctuations in the annual fisheries catch, ranging from +33 percent to —9 percent, are shown in Figure 2 and Table 1. It should be noted that catch fluctuations became smaller in the 1960's and early 1970's indicating a more stable fishery. The 1974 decline, explained above, may be a harbinger of other similar declines in the future as extended jurisdictions

Figure 1.—Taiwan's fisheries catch (in 1,000 metric tons) in historic perspective, 1945-81. Sources: "Taiwan Agricultural Yearbook," 1975; *China Post*.

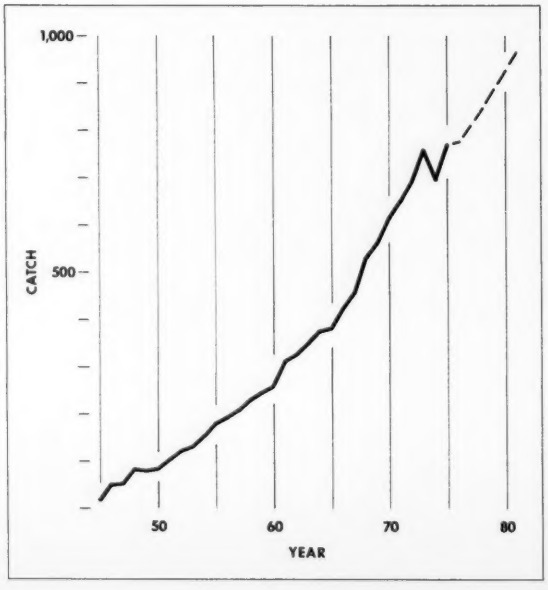


Figure 2.—Annual changes in Taiwan's fisheries catch (in percent of previous year), 1947-81. Sources: "Taiwan Agricultural Yearbook," 1975; *China Post*.

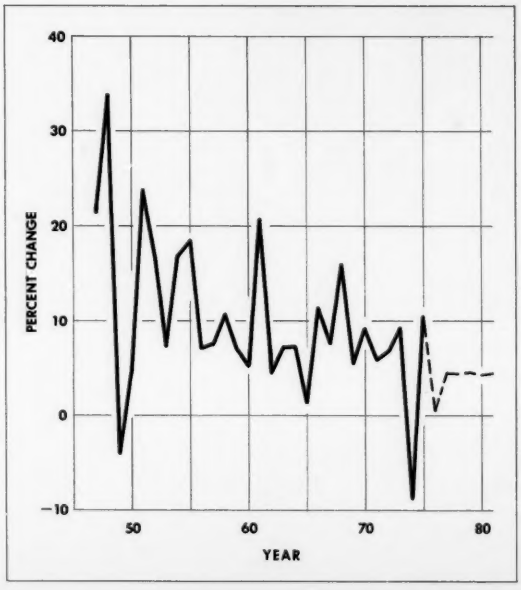


Table 1.—Taiwan's fisheries catch in historic perspective, 1945-1981.

Year	Quantity[1]	Change (%)[2]	Year	Quantity[1]	Change (%)[2]
1945	16.9		1964	376.4	7.3
1946	51.5	204.7	1965	381.7	1.4
1947	52.5	21.4	1966	425.3	11.4
1948	83.5	33.6	1967	458.1	7.7
1949	80.4	—3.9	1968	531.0	15.9
1950	84.2	4.7	1969	560.8	5.6
1951	104.2	23.8	1970	613.0	9.3
1952	121.7	16.8	1971	650.1	6.0
1953	130.6	7.3	1972	694.2	6.8
1954	152.5	16.8	1973	758.4	9.2
1955	180.6	18.4	1974	697.7	—8.7
1956	193.4	7.1	1975	770.5	10.4
1957	208.1	7.6	1976[3]	775.0	0.6
1958	230.0	10.5	1977[3]	810.0	4.5
1959	246.3	7.1	1978[3]	846.0	4.4
1960	259.1	5.2	1979[3]	886.0	4.7
1961	312.4	20.6	1980[3]	924.0	4.3
1962	327.0	4.7	1981[3]	966.0	4.5
1963	350.7	7.2			

[1]Quantity in 1,000 metric tons.
[2]Increase or decrease (—) in percent of previous year.
[3]Fishery Development Plan forecasts.
Sources: *Taiwan Agricultural Yearbook*, 1975, for 1945-1974 data; and the *China Post*, for 1975 data and for 1976-1981 estimates.

and diminishing world fishery resources take their toll. The Taiwanese Government has projected a large leveling off of its fisheries catch during the next 6 years to an average growth rate of 4.5 percent each year (Fig. 2).

DANES EXPAND WHITING QUOTA

The Danish Government announced on 1 September that it would increase its quota of whiting to 114,000 metric tons (t) in response to rising demands by the fishing industry. The Northeast Atlantic Fisheries Commission (NEAFC) had initially set the Danish 1976 whiting quota at 74,000 t, but the Danes announced in early spring that they were increasing it to 94,000 t and have now raised it an additional 20,000 t, bringing the total allocation to 114,000 t.

The Danish Government officially objected to the NEAFC whiting quota when allocations were established and was therefore free to exceed the quota under the rules of the Commission. The Danish haddock and cod quotas were also almost filled, but the Government had not discussed increases in those quotas. The whiting quota was 96 percent filled when the decision to increase it was made; the 1976 Danish haddock quota (40,350 t) was 85 percent filled and the cod quota (43,700 t) about 80 percent filled, as of August.

Fisheries Minister Poul Dalsager was under heavy pressure from the fishing industry to increase either the whiting quota or Government assistance to the fishing industry, and chose to expand the quota. Whiting is a fish caught as a by-catch for reduction to fish meal; it comprises approximately 20 percent of the directed fisheries for sprat and Norway pout, the two major species of the Danish reduction fishery.

According to theA NMFS Office of International Fisheries, Danish fishermen were pleased by the expanded quota in response to what they feel is an abundant year for whiting and industrial fish. Fisheries Minister Dalsager explained that it was difficult to set catch quotas in advance in areas where the stocks fluctuate so rapidly. Such action cannot, however, be beneficial to the international position of the Northeast Atlantic Fisheries Commission, which initially set the quotas. In a related development, Scottish fishermen threatened to exceed their quota for haddock unless the United Kingdom pressed for a 50-mile fisheries limit within the Common Market. (Source: Berlingske Tidende.)

Russia Produces New Fishing Vessel Classes

Two fishing vessel classes with similar names but different purposes, the *Piatdesiat Let SSSR* and the *Piatidesiatiletie SSSR*, went into serial production in the Soviet Union in the early 1970's. Both classes were named in honor of the fiftieth anniversary of the USSR, a celebration which took place in 1967. *Piatdesiat Let SSSR* means "Fifty Years of the USSR", while *Piatdesiatiletie SSSR* means "The Fiftieth Year of the USSR".

The *Piatdesiat Let SSSR*, which became operational in 1973, is a three-deck refrigerated transport vessel built at the Kommunards Shipyard in Nikolaev on the Black Sea. This vessel is the prototype of the new *Piatdesiat Let SSSR* class, which was formerly called *Beringov Proliv* class. It is designed to transport fish and fishery products from the fishing grounds, and to supply trawlers with fuel, fresh water, and food. The vessel's engines operate automatically and all loading and unloading operations are mechanized. Containers can also be carried on board.

A second vessel in the series, the *Druzhba Naroda*, was built in 1973. Dozens of vessels of this class are planned for construction, which is reportedly to last until 1990. The new transports will ply the waters between the ports of the European USSR and those of the Soviet Far East.

The other new class, *Piatidesiatiletie SSSR*, formerly *Pos'et* class, is a series of five fish-meal and fish-processing factory baseships under construction at the Admiralteiskii Shipyard in Leningrad. This class is exceeded in size and capacity only by the *Vostok*, the flagship of the Soviet fishing fleet. Vessels of this class are designed to operate with a fleet of catcher vessels and to assist in the development of presently underutilized marine species. The major productive capacity of the class is geared for the reduction of fish into meal and oil. Two vessels in the series have so far been built, *Piatidesiatiletie SSSR* and *Vasilii Chernyshev*.

Piatdesiat Let SSSR	Specifications	*Pietidesiatiletie SSSR*
18,500-19,630 DPL	Displacement	26,500-29,100 DPL
172.1 m	Length	197.3 m
23.0 m	Width (beam)	26.4 m
8.1 m	Draft	7.8 m
13,083 GRT	Gross register tons	18,454 GRT
11,300 DWT	Deadweight	13,041 DWT
16,200 t	Storage capacity	18,000 t
	Processing capacity	750 t/day total 600 t/day fishmeal and oil
19 knots, max.	Speed	14.5 knots
6DKRN74/160-3	Engine number	6DKRN74/160-2
diesel	Engine type	diesel
11,600	Horsepower	9,000
	Engine rpm	115
7,100 m³	Fuel capacity	8,800 tons
90 days	Endurance	30 days
25,000 miles	Range	
	Crew	500
Air-refrigeration plant can maintain temp. at —28°C; anti-pollution equipment	Special equipment	

Foreign Fishing Boat Seizures Increase Off U.S. Coastline

The number of foreign vessels seized off U.S. coasts has increased dramatically since 1967. In that year, the U.S. Coast Guard began enforcing a 9-mile Contiguous Fishing Zone (CFZ), which was legislated by Congress in October 1966. Foreign vessels fishing in the CFZ are subject to seizure and prosecution under the Bartlett Act (16 U.S.C. 1081-1086). The vessel and its entire gear and cargo may be forfeited, while the captain may be imprisoned up to one year or fined up to $100,000, or both. Often, however, seizures for violations of the Bartlett Act are not brought to trial; instead, settlement in the form of a fine is decided upon by the two parties. The defendants plead no contest, a judgment is entered by the court, and the case is closed with payment of the agreed fine.

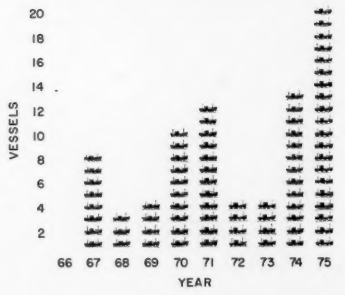


Figure 1.—Foreign fishing vessels seized by the United States, by number and year, 1966-75. Source: Division of International Fisheries Analysis, NMFS, NOAA, U.S. Department of Commerce.

Between 1967 and 1973, the number of foreign fishing vessels seized each year by the United States fluctuated between 3 and 12; in 1974, however, 13 vessels were seized, and by the end of 1975, the number had reached 20 (Fig. 1). This sudden increase in vessel seizures resulted partly from stricter enforcement of the CFZ by National Marine Fisheries Service (NMFS) enforcement agents and Coast Guard personnel. Another important factor, however, was the initiation of seizures for Continental Shelf Fishery Resource (CSFR) violations.

The Bartlett Act, besides CFZ provisions, also prohibits foreign fishermen from intentionally taking and retaining lobster, crab, and other creatures of the Continental Shelf[1]. The CSFR violations carry the same penalties as CFZ violations, but were not enforced strictly until late 1974. At that time, the U.S. Government issued warnings to the captains of foreign vessels fishing off the coasts of the United States. According to CSFR

[1]The Bartlett Act defines Continental Shelf fishery resources as "the living organisms belonging to sedentary species; that is to say, organisms which, at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed, or the subsoil of the Continental Shelf."

Table 1.—Foreign fishing vessels seized off the U.S. coasts by country, number of vessels, and fines levied in U.S. dollars; 1967-1976.

Country	Total	[1]1976	1975	1974	1973	1972	1971	1970	1969	1968	1967
U.S.S.R.											
Number	10	1	1	1	—	2	2	—	—	—	3
Fines	1,145,000	410,000	100,000	250,000	—	250,000	100,000	—	—	—	35,000
Japan											
Number	21	2	5	2	1	2	1	4	3	—	1
Fines	3,217,000	580,000	1,178,000	750,000	230,000	180,000	115,000	160,000	19,000	—	5,000
Canada											
Number	28		2	6	2	—	5	5	1	3	4
Fines	26,588		1,000	6,000	—	—	5,755	10,589	419	1,105	1,720
W. Germany											
Number	1		—	—	—	—	—	1	—	—	—
Fines	20,000		—	—	—	—	—	20,000	—	—	—
Cuba											
Number	8	1	2	1	—	—	4	—	—	—	—
Fines	90,500	40,000	—	25,000	—	—	25,500	—	—	—	—
Bulgaria											
Number	2		1	1	—	—	—	—	—	—	—
Fines	550,000		425,000	125,000	—	—	—	—	—	—	—
Romania											
Number	1		—	1	—	—	—	—	—	—	—
Fines	125,000		—	125,000	—	—	—	—	—	—	—
Mexico											
Number	1		—	1	—	—	—	—	—	—	—
Fines	3,900		—	3,900	—	—	—	—	—	—	—
Italy											
Number	2		2	—	—	—	—	—	—	—	—
Fines	65,000		65,000	—	—	—	—	—	—	—	—
Poland											
Number	4		4	—	—	—	—	—	—	—	—
Fines	1,245,000		1,245,000	—	—	—	—	—	—	—	—
Rep. of Korea											
Number	3	1	1	—	1	—	—	—	—	—	—
Fines	1,035,000	530,000	415,000	—	90,000	—	—	—	—	—	—
Spain											
Number	2	1	1	—	—	—	—	—	—	—	—
Fines	125,000	100,000	125,000	—	—	—	—	—	—	—	—
Taiwan											
Number	1		1	—	—	—	—	—	—	—	—
Fines	205,000		205,000	—	—	—	—	—	—	—	—
Grand total											
Number	84	6	20	13	4	4	12	10	4	3	8
Fines	7,852,988	1,660,000	3,759,000	1,284,900	320,000	430,000	246,255	190,589	19,419	1,105	41,720
Average fine per vessel	93,488	276,666	187,950	98,838	80,000	107,500	20,521	19,059	4,855	368	5,215

[1]Data through 4 May 1976; 1 Japanese vessel had not been fined as of that date.
Source: Law Enforcement Division, F35, National Marine Fisheries Service, NOAA, U.S. Department of Commerce, Washington, D.C.

regulations, creatures of the Continental Shelf must be returned to the sea immediately after they are brought on board a vessel and retrieved from the nets. All such catch, no matter how small, must appear in the vessel's logbook.

The first seizures for CSFR violations occurred in early 1975. Penalties have been stiff; one Bulgarian vessel, for example, was fined $425,000 for lobster retention. Fines for vessel seizures in general have become progressively higher since 1967. In that year, the average penalty per vessel was only $5,215. In 1970, the figure increased to $20,521, and by 1975 it had reached $187,950. (For complete statistics on seizures and fines, see Table 1.)

According to the NMFS Office of International Fisheries, the average annual fines do not show the wide fluctuation in the penalties paid by individual vessels from various countries. For example, in 1975 two Canadian vessels were seized and fined $1,000, or a vessel average of $500. That same year, four Polish vessels were fined $1,245,000 for an average of $311,250 each.

The amount of the fine depends, to a large extent, on the circumstances of the violation. The U.S. Coast Guard and NMFS fishery enforcement agents had noted several infractions by Polish vessels before the actual seizures took place in 1975. Inspections showed that Polish vessels were fishing in a river herring closure area prohibited to them under the terms of the U.S.-Poland Mid-Atlantic Bilateral Agreement. Also, Polish vessels had been reported fishing for herring in the Gulf of Maine, although Poland had no catch quota there under the International Commission for Northwest Atlantic Fisheries (ICNAF).

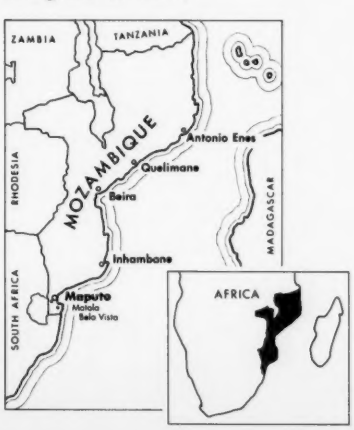
Canadian vessels are most often seized off U.S. coasts for the violation of international conventions protecting Pacific halibut, sockeye salmon, and pink salmon. (U.S. vessels are also governed by these conventions.) Fines for such seizures are lower because they represent only the value of the illegal fish catch on board, rather than the value of the entire vessel with its gear and cargo, which is the penalty for violations of the Bartlett Act. If a vessel is seized for a second or third offense, the fines can go higher, perhaps eventually leading to confiscation of the vessel. However, Canadian and U.S. fishing captains have not in the past been multiple offenders, and the fines have remained relatively low.

The Fishery Conservation and Management Act of 1976 (P.L. 94-265) was signed by President Gerald R. Ford on 13 April 1976 and goes into effect on 1 March 1977. Under this Act, the catch quotas allocated to individual foreign nations fishing within 200 miles of U.S. coasts will be determined, in part, by the cooperation they have shown U.S. fishery enforcement programs in the past. Foreign fishermen with a poor record of cooperation can expect to have their quotas curtailed at least to some extent by this measure.

Mozambique Reports Shrimp Developments

New Mozambique regulations have increased prices for most grades of shrimp sold in both domestic and export markets. Some prices were reduced for shrimp sold heads-off for export. The higher shrimp prices were implemented as the result of increasing fuel and labor costs.

The Mozambique Department of Commerce on 6 January 1976 set new shrimp prices for domestic sales effective in the Districts of Maputo (formerly Lourenco Marques), Bela Vista, Matola, Gaza, Inhambane, and Beira. The new domestic retail shrimp prices for whole shrimp varied from a high of US$3.33 per kg for the jumbo grade to a low of US$1.17 per kg for the very small grade (Table 1).



A second notice from the Mozambique Department of Commerce on 14 January 1976 also changed the FOB minimum export prices for heads-on and heads-off shrimp (Tables 2, 3). Shrimp for export fall into the first five grades only; the Government does not permit the exportation of the last two grades (2 and 3) of very small shrimp (shrimp with a count of over 101 per kg). Minimum export prices are set for those Mozambique marine ports which

Table 1.—Mozambique whole shrimp prices (US$/kg) by grade on domestic markets, 1976.

Grades	Count per kg	Length in cm[1]	Price[2] Wholesale	Price[2] Retail[3]
Jumbo	< 14	>20	3.00	3.33
Large	14-25	18-20	2.50	2.83
Medium	26-40	16-18	2.33	2.67
Small	41-60	14-16	1.83	2.17
Very small (1)	61-100	12-14	1.50	1.83
Very small (2)	101-400	8-12	1.17	1.50
Very small (3)	>400	< 8	0.83	1.17

[1]The length of the shrimp is measured from the telson to the rostrum. For headless shrimps the domestic sale prices may be increased by 50 percent.
[2]Prices are calculated at an exchange rate of 30 Mozambique escudos equals US$ 1.00.
[3]The Mozambique Government allows retailers to charge 10 escudos per kg (US$0.33) over the wholesale price.

Table 2.—Mozambique minimum export prices (US$/kg, FOB) for heads-on shrimp, 1976, compared with 1975.

Grade	Count per kg	Price[1] 1976	Price[1] 1975
Jumbo	< 14	4.66	4.00
Large	14-25	3.50	2.83
Medium	26-40	3.16	2.50
Small	41-60	2.66	2.00
Very small (1)	61-100	2.33	1.66
Very small (2)	Exports not permitted		
Very small (3)	Exports not permitted		

[1]30 escudos = US$1.

Table 3.—Mozambique minimum export prices (FOB) for heads-off shrimp.

Grade	Count per kg	Prices[1] (US$/kg) White shrimp 1976	Brown shrimp 1976	Both 1975
Jumbo	<23	5.33	5.00	6.00
Large	23-33	4.66	4.33	—
Large	34-44	4.33	5.00	4.17
Medium	45-55	4.00	3.66	—
Medium	56-66	3.66	3.33	3.67
Small	67-88	3.33	3.00	—
Small	89-110	3.00	2.67	3.00
Very small	111-132	2.67	2.50	—
Very small	133-154	2.50	2.33	2.50

[1]30 escudos = US$1
Source: U.S. Embassy, Maputo.

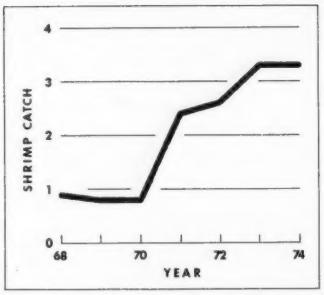


Figure 1.—Mozambique shrimp catch, 1968-1975, in thousands of metric tons. Source: FAO, "Yearbook of Fishery Statistics," various years.

Table 4.—Japanese and United States imports of Mozambique shrimp by quantity (t) and value (US$1,000) 1974-75.

Country, Import	1975 Quantity	1975 Value	1974 Quantity	1974 Value
Japan				
Shrimp (frozen)	989.9	[3]3,909.5	485.3	[4]1,901.8
U.S.				
Shrimp (frozen)[1]	0.0	0.0	0.6	2.4
Other[2]	13.9	18.0	21.4	25.9
Total U.S.	13.9	18.0	22.0	28.3

[1]Shell-on.
[2]Other shellfish includes various shellfish pastes and sauces, but excludes rock lobster imports.
[3]Based on the exchange rate of US$1 = 303 yen, valid on 31 December 1975.
[4]Based on the exchange rate of US$1 = 299.8 yen, valid on 31 December 1974.
Source: Japanese Ministry of Finance. *Japan Exports and Imports 1974, 1975,* and U.S. Department of Commerce, Bureau of the Census.

are reached by international shipping. For smaller ports, reached only by coastal vessels, a deduction of US$0.17 per kg is allowed.

SHRIMP CATCH

Mozambique's 1974 shrimp catch of 3,300 metric tons (t) represents a 270 percent increase over the 900 t harvested in 1968 (Fig. 1). Catch data for 1975 is not yet available.

SHRIMP EXPORTS

Japanese imports of frozen shrimp from Mozambique increased significantly in 1975. In 1974, Japan imported 785 t of Mozambique shrimp worth US$1.9 million. By 1975, the quantity of shrimp imports increased to 990 t worth US$3.9 million. United States imports of Mozambique shrimp are negligible (Table 4).

OTHER DEVELOPMENTS

The new Mozambique Government has begun to reorganize the country's fishing industry. Cooperatives have reportedly been established and administrative boards have been appointed to manage two of the largest fishing companies in Mozambique, IMPESCAL and COPESCA, both of which were nationalized by the FRELIMO Government. Due to reports of activity by Mozambique gunboats, many of the South African shrimp trawlers, which operated off Mozambique, have withdrawn from that fishery and are being converted for lobster fishing along the South African coast.

The first 8 of 25 new fishing vessels ordered from Brazil were to be delivered to Mozambique last April. The vessels have reportedly been ready since July 1975, but their delivery was delayed due to negotiations with Mozambique authorities and the changing political situation there. In addition, 17 shrimp trawlers are now being built at the INCONAV Shipyard in Niteroi, Brazil. The 31 meter, all-purpose trawlers are powered by 1,200 hp engines and equipped with radar, echo sounders, and refrigerated holds. The vessels will operate off Quelimane and Antonio Enes (see map).

The catch will be deep-frozen in a cold storage plant to be built near Beira. The new vessels will significantly increase the capacity of Mozambique's shrimp fleet. ARPEM, the Portuguese company, which ordered the 17 new shrimp trawlers, previously operated a fleet of only three wooden and three steel trawlers from Mozambique ports.

Thai Shrimp Fishery, Exports Show Growth

CATCH

In the last 20 years Thailand's shrimp catch has increased dramatically (Fig. 1), according to data from the "Yearbook of Fishery Statistics" of the United Nations Food and Agriculture Organization. From 13,500 metric tons in 1959, the Thai shrimp catch soared to a peak of 107,500 metric tons in 1973. A 96,200-metric ton catch was recorded in 1974.

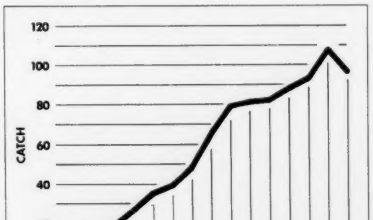


Figure 1.—The Thai shrimp catch in 1,000 metric tons, 1959-1974. (Source: FAO "Yearbook of Fishery Statistics.")

PRICES

Shrimp prices rose on the Bangkok market during the first half of 1976. Tiger shrimp on the Bangkok market rose gradually from a maximum large shrimp price of $5.50 per kilogram to $5.70 per kilogram, king shrimp from $4.00 to $5.00, pink shrimp from $3.75 to $4.75, and white shrimp went from a price of $4.90 to $5.50 per kilogram (Table 1).

Table 1.—Thai monthly marine shrimp prices (in US$/kg) at Bangkok fish market, Jan.-July 1976.

End of month		Tiger L	Tiger M	Tiger S	White L	White M	White S	King L	King M	King S	Pink L	Pink M	Pink S
Jan.	Min.	5.00	3.50	1.75	4.00	2.75	1.00	3.50	1.50	1.00	3.00	1.00	0.50
	Max.	5.50	4.50	2.25	4.90	3.25	1.75	4.00	2.00	1.50	3.75	1.40	0.80
Feb.	Min.	4.50	3.00	1.50	3.50	2.50	1.25	3.00	1.50	0.75	2.50	1.20	0.50
	Max.	5.00	3.50	2.25	4.00	3.25	1.75	3.75	2.00	1.25	3.00	1.40	0.80
March	Min.	5.10	3.50	1.75	4.30	2.25	1.10	3.50	1.75	1.15	3.25	1.30	0.75
	Max.	6.00	4.75	2.25	5.00	3.50	1.50	4.00	2.70	1.50	4.30	2.25	1.10
April	Min.	5.50	3.75	2.00	4.00	2.50	1.40	3.75	1.75	1.40	3.90	1.50	0.90
	Max.	5.90	4.50	2.50	4.90	3.50	1.75	4.40	2.25	1.50	4.25	2.00	1.25
May	Min.	5.00	3.50	2.00	4.65	3.00	1.25	4.00	2.00	1.50	4.00	1.75	0.75
	Max.	5.75	4.50	2.50	5.50	3.75	1.75	4.50	2.50	1.75	4.50	2.00	1.25
June	Min.	4.75	3.50	2.00	4.25	3.00	1.15	3.75	2.25	1.25	3.75	1.50	0.75
	Max.	5.70	4.50	2.40	5.10	3.75	1.70	4.75	2.75	1.75	4.70	2.15	1.25
July	Min.	5.25	3.50	2.25	4.00	2.50	1.10	4.00	2.50	1.25	3.75	1.75	0.75
	Max.	5.70	4.50	3.00	5.50	3.50	1.75	5.00	3.00	1.75	4.75	2.00	1.25

Source: American Embassy, Bangkok. Thai baht is converted to U.S. dollars at 20:1.

Table 2.—Thai monthly exports of fresh and frozen shrimps, prawns, and lobsters, 1976.

Month	Quantity				Value			
	U.S.	Japan	Other[1]	Total[2]	U.S.	Japan	Other	Total
	Metric tons				*US$ million*			
Jan.	75	947	299	1,321	0.4	5.2	0.4	6.0
Feb.	114	669	290	1,073	0.5	3.6	0.6	4.7
March	188	659	344	1,191	0.9	2.8	0.6	4.3
April	124	863	216	1,203	0.6	3.8	0.5	4.9
May	135	664	223	1,022	0.6	5.0	0.2	5.8
June	230	879	270	1,379	1.2	4.5	0.4	6.1

[1] Mostly to Hong Kong.
[2] Shrimp comprise the vast bulk of the total export figures.
Source: American Embassy, Bangkok.

EXPORTS

Thailand exported more than 1,000 metric tons (t) of shrimp each month during early 1976 (Table 2). Total exports fluctuated a little, going from 1,321 t in January to 1,379 t in June. In June, 230 t went to the United States, 879 t to Japan, and 270 t went to other destinations, mainly Hong Kong. According to official trade statistics, shrimp exports were worth $31.8 million in the first half of 1976.

Table 3.—Thai shrimp exports in metric tons, 1957-1975.

Year	U.S.	Japan	Other	Total
1957	—	—	7	7
1958	—	—	39	39
1959	24	—	174	198
1960	20	—	922	942
1961	14	—	875	889
1962	131	42	1,106	1,279
1963	567	456	1,030	2,053
1964	413	1,079	1,922	3,414
1965	1,066	1,773	2,041	4,880
1966	1,381	3,621	2,880	7,882
1967	1,493	5,104	2,232	8,829
1968	1,720	4,248	1,322	7,290
1969	1,115	4,949	2,069	8,133
1970	1,152	3,643	1,626	6,421
1971	469	3,447	1,677	5,593
1972	1,260	3,864	1,601	6,725
1973	1,741	10,926	2,208	14,875
1974	1,588	6,577	2,086	10,251
1975	1,362	9,533	2,640	13,536

Source: *Bank of Thailand Monthly Bulletin*, April 1976.

Exports of Thai shrimp have also increased (Table 3). In 1964 Japan replaced the U.S. as the largest single customer for Thai shrimp. Since then, Thai exports to the United States and elsewhere, excluding Japan, have remained fairly constant. But since 1965, Japan has increased its imports of Thai shrimp from 1,773 t per annum to 9,533 t in 1975, a 438 percent increase. Thai shrimp exports, following the Japanese demand, have also increased since 1965, going from 4,880 t to 13,536 t in 1975.

Since 1973, Japan has continued its large purchases of shrimp and now imports about 65 percent of all Thai shrimp exports. The United States imports 13 percent of total Thai shrimp exports, and Hong Kong is the next largest importer. Smaller quantities go to Australia, Italy, the Netherlands, France, New Zealand, Canada, West Germany, and the United Kingdom. (Sources: American Embassy, Bangkok; *Bank of Thailand Monthly Bulletin*; FAO "Yearbook of Fisheries Statistics."

Greece Reports 1975 Fish Catch Decline

The total Greek fisheries catch in 1975 was 98,000 metric tons (t), or 17 percent less than the 117,000 t caught in 1974. Declining catches in the Atlantic, Mediterranean, outer coastal, and coastal fisheries were due to increasingly limited fishing grounds and stocks. The inland water fishery, consisting of 15 lakes and 50 lagoons, was the only sector where the catch increased, primarily because of expanded trout culture (Table 1).

Total value of the 1975 fisheries catch was US$92.6 million compared to US$119.4 million in 1974, or 22 percent less. Higher fuel costs and license fees, in addition to labor problems, led to losses in income of the average Greek fisherman in 1975.

UTILIZATION

Greek vessels land a wide variety of fish. The most important species are sea bream, European pilchard and mackerel. Attempts to introduce North Atlantic species into the Greek markets have met with only limited success. There is no significant fish processing industry in Greece and practically all domestic production is marketed fresh, chilled, or frozen. Small quantities of the catch are canned, but production does not exceed 500 t annually. Fisheries consumption declined from 13.2 kg per person in 1974 to 10.6 kg in 1975.

Table 1.—Greek fish catch, by fishery in metric tons, 1974-1975.

Fishery	1975	1974	Percent change
Distant-water	23,900	28,900	—17.3
Mediterranean	3,600	6,000	—40.0
Outer coastal	46,000	54,000	—14.9
Coastal	12,000	16,000	—25.0
Inland water	6,500	5,000	+30.0
Subsistence	6,000	8,000	—25.0
Total	98,000	[1]117,000	—17.0

[1] The total for 1974 does not agree with FAO estimated catch in Figure 1.
Source: *Alieia Fishing.*

TRADE

Because the catch is consumed domestically, exports are limited, with the exception of a few specialty products such as eels and shrimp. Fishery imports are used mainly for animal feed and have declined since 1971. In 1974, Greece imported 23,600 t of fishery products compared to 31,000 t in 1973.

FLEET

Approximately 25,000 small craft fish in coastal waters, using longlines, beach seines, and trammel nets. Most fishermen engaged in coastal fishing are subsistence fishermen, marketing little of their catch. The "mid-water" (outer coastal) fishery consists of a fleet of 750 small trawlers, purse seiners, and a few multi-purpose vessels. Half of the Greek landings are caught by the outer coastal fleet.

Table 2.—Greek fishery vessels sighted in sub-area 5 of ICNAF, by type and number of vessels, 1961-1975.

Year	Type of vessel[1]				Type of vessel[2]			
	Stern	Medium	Support	Total	Stern	Medium	Support	Total
1968	—	1	—	1	—	1	—	1
1969	—	2	—	2	—	1	—	1
1970	—	2	—	3	—	1	—	1
1971	—	4	—	4	—	2	—	2
1972	—	3	—	3	—	2	—	2
1973	1	—	—	1	1	—	—	1
1974	2	—	—	2	1	—	—	1
1975	—	—	—	—	—	—	—	—

[1]Figures are the sum of monthly sightings including duplicate sightings.
[2]Figures represent individual vessels sighted during the year, exclusive of duplication.
Source: Law Enforcement Division, NMFS, NOAA, U.S. Department of Commerce.

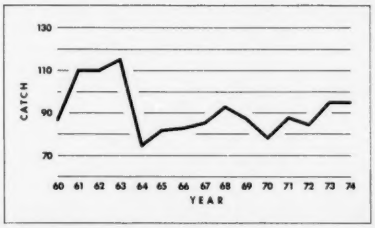


Figure 1.—Greek fisheries catch, 1960-1974, in 1,000 metric tons. Source: FAO "Yearbook of Fisheries Statistics," 1974.

The distant-water fishery consists of about 50 larger vessels fishing in the Atlantic, mainly under bilateral agreements with coastal states. Bilateral agreements have been signed with Gambia, Guineau-Bissau, and Mauritania. Yet, as fishing zones are extended by African states and fishery stocks in adjacent water become depleted by larger, more modern fleets of other countries, the Greek distant-water fleet finds itself at a competitive disadvantage. To remedy the situation, distant-water trawler owners have recently petitioned the Greek government for increased assistance and subsidies to modernize the fleet. Greek fishing off the U.S. Atlantic coast began only in 1968 and remains negligible (Table 2).

CONCLUSION

The Greek fisheries catch has not expanded significantly during the past 10 years and continues to fluctuate without any discernible trend (Fig. 1). The economic crisis of the past 2 years, however, has severely hampered fishing operations, particularly for the distant-water fleet, while the Mediterrean offers little prospect for large and sustained catch increases. (Sources: *Alieia Fishing: OECD Review of Fisheries*, 1974.)

Foreign Fisheries Translations Printed

Following are abstracts of recent articles and papers translated by the NMFS Language Services Division. Copies of the full translations are available from the Language Services Division, F43, Office of International Fisheries, NMFS, NOAA, U.S. Department of Commerce, Washington, DC 20235:

"Nichiro Joins in Krill Harvesting." According to an article in *Suisan Shuho*, No. 771, 25 May 1976, the giant Nichiro Gyogyo Company is planning to start Antarctic krill harvesting in the fall. Nichiro harvested about 10,000 metric tons (t) of shrimp (*Penacopsis akaebi*) in the northern seas annually through 1972. The company canned this krill-like tiny shrimp for marketing. This experience makes the company confident in the successful processing of krill. Last fall the four largest Japanese fishing companies (Taiyo, Nippon Suisan, Nichiro, Kyokuyo) all harvested krill in the Antarctic Ocean.

"Japanese Fishing Industry Use of Fuel Oil." An article in *Suisan Shimbun*, No. 3710, 31 March 1976, reports that the Japanese fishing industry used 5,500,000 kl of fuel oil in 1975. The eleven major companies account for 1,186,000 kl or 22 percent of the total. The small and medium-sized companies together with coastal fishermen used the remaining 4,314,000 kl. The following table shows the account of fuel used by the major companies:

Taiyo	442,000 kl
Nippon Suisan	270,000
Nichiro	130,000
Kyokuyo	130,000
Hoko Suisan	50,000
Hokuyo Suisan	46,000
Hokkaido Gyogyo Kosha	41,000
Hakodate Kokai	26,000
Hokoku Suisan	25,000
Shinsei Suisan	14,000
Nippon Hogei	7,000
Total	1,186,000 kl

"Questions of Ogenesis of Atlantic Longfin Squid (*Loligo pealei* Les.) of Georges Bank." This article by P. N. Burukovskii and A. N. Vovk, found in the *Archive of Anatomy, Histology, and Embryology* (*Arkhiv anatomii gistologii, i embriologii*), Vol. 66, Issue 5, 1974, pp. 44-50, has been translated by the Multilingual Services Division of the Department of the Secretary of State of Canada. It describes the development of the gonads in female *Loligo pealei* squid. The development phases and disposition of oocytes and the gonad structure are also discussed. A supposition is made on the monocyclic nature of the squid and a scale for determining gonad maturity in females is also presented.

"Whaling Season Begins." An article in *Suisan Shuho*, No. 711, 25 May 1976, reports that the newly formed Japanese whaling company, Kyodo Hogei, had begun whaling. The 23,086 t mothership No. 3 *Kyokuyo Maru* reportedly sailed from Yokohama on 24 May for the whaling grounds near the Hawaiian Islands. *Shonan Maru* and eight other catcher boats were to rendezvous with the mothership at the grounds to form a 10-vessel fleet. They planned to catch 578 North Pacific Bryde's whales and 1,497 sperm whales during the season. Their processing plan was as listed below.

	Bryde's whales	Sperm whales
Oil	1,156 t	5,000 t
Frozen meat	4,046 t	2,290 t
Meal	87	200
Other	nil	3
Total	5,289 t	7,493 t

"Japanese Fish Catches Within 200 Miles of Foreign Shores." An article in *Suisan Shimbun*, No. 3515, 14 April 1976, discusses the 1974 Japanese fish catches within 200 miles of foreign shores. According to the latest available Japanese Government catch statistics, in 1974 Japan caught, 4,477,000 t of fish in such waters. This figure represents a 79,000 t decrease from the 1973 catch of 4,566,000 t. Reduced catches from the waters near the United States and the Soviet Union account for this decline. Due to price increases, the 1974 catch was worth 511.7 billion yen (US$1.54 billion), while the larger 1973 catch was worth 420.2 billion yen (US$1.26 billion). The following table shows the catches and values by ocean areas:

	1973		1974	
Area	Catch	Value[1]	Catch	Value[1]
Pacific (northern)				
Bering Sea and North Pacific	2,191.8	1,125.6	1,909	1,178
Sea of Okhotsk (northern)	428.1	254.7	622	353
Sea of Okhotsk (southern)	700.9	352.5	632	547
Sea of Japan (northern	227.0	221.8	269	314
Sea of Japan (southern)	18.4	30.9	18	54
Yellow Sea & East China Sea	363.2	545.8	373	728
Subtotal	3,929.4	2,531.3	3,823	3,174
Pacific (middle)	199.3	517.6	264	862
Pacific (southern)	92.4	327.7	86	271
Atlantic (northern)	46.3	74.1	40	121
Atlantic (middle)	127.7	274.2	130	352
Atlantic (southern)	134.5	341.9	105	203
Indian Ocean	26.7	135.1	29	134
Grand total	4,556.3	4,201.9	4,477	5,117

[1]Values are listed in 100 million yen (US$333,000).

Cuban Fishermen Fined by Bahamian Court

Bahamian authorities arrested 17 Cuban fishermen south of Andros Island on 30 August. After changing their plea to guilty on 7 September, they were fined a total of $10,250 for fishing in the Bahamian exclusive fishing zone. Their Spanish-speaking lawyer, who regularly handles such cases for the Cuban Government, asked the Bahamian court for mercy on the grounds that the fishermen were unaware of the Bahamian exclusive fishing zone and that they were, at the time of the arrest, searching for another vessel reported missing by the Cuban Coast Guard. He added that charges of Cuban patrol units attempting to interfere with Bahamian Marine Division agents were untrue and that Cuban patrol activity was part of the alert for the missing fishing vessel "Bonita".

The Bahamian Minister of External Affairs indicated on 4 September that there was no evidence that Bahamian vessels were being harassed by the Cuban Coast Guard. He did say, however, that the Bahamian police boat involved in the arrest of the Cuban fishermen had reported being overflown by an unidentified airplane (DC-3) and sighting unidentified high-speed boats.

According to the NMFS Office of International Fisheries, 20 Cuban fishermen were arrested in December 1975 for fishing off Cay Verde and fined $30,000. Part of their catch (Nassau groupers and other finfish) was distributed to local charities and the proceeds of the sale of the remaining catch went to the Bahamian Government. Another group of six Cuban fishermen, arrested on 6 December 1975 were released when they explained that they had only entered Bahamian waters to avoid bad weather.

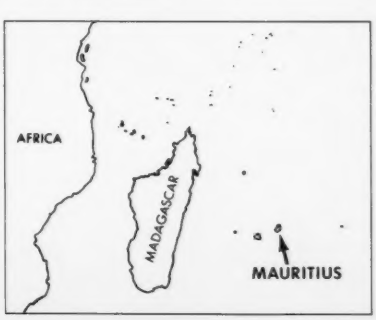
Cuban officials had requested discussions with the Bahamas on fishery matters earlier in the year. Bahamian Prime Minister Lynden Pindling, on 13 April 1976, virtually ruled out the possibility of any fishing agreement which would grant Cuba even limited access to Bahamian fishery resources. According to Pindling, " . . . in all fairness and honesty to them (Cuba), we had to inform them that the likelihood of success of any such talks was extremely slim."

Mauritius to Build New Fish Hatchery

Fifteen acres of land have been acquired at Albion[1] for the construction of a new fish hatchery, a laboratory, and an aquarium. The complex itself will cover approximately 15,000 ft^2 and will be the largest and most modern complex of its kind in the world, according to a statement by the Senior Fisheries Officer, David Ardill. It will have both fresh and salt water breeding and holding pools. The new hatchery complex will be complementary to the Trou d'Eau Douce prawn hatchery, but may also include experiments with fish other than carp and mullet which have already been successfully acclimatized to fresh water. The Albion project combines the concept of creating a hatchery for research purposes with the idea of preserving the natural environment, according to the statement.

The location of the hatchery was dictated by the need for large quantities of unpolluted fresh and salt water. The project is still in the planning stage, but the Ministry of Fisheries wants the facility flexible enough for all types of fish culture. The project is being funded solely by the Mauritian Government which is making an effort to increase the utilization of marine and freshwater resources to make the country self-sufficient in fish. Even though Mauritius is an island surrounded by significant marine resources, freshwater fish culture makes sense because fresh water is available on the islands and also as part of a program by sugar plantations to diversify. (Source: U.S. Embassy, Port Louis.)

[1]Located 10 miles north of Port Louis on the island of Mauritius.



Snook, Chinook, and the Geoduck

. . . . **Hatchery production may one day bolster** Washington States' goeduck clam stocks, reports the Washington Department of Fisheries. Adult geoducks, the states' largest hardshell clam, have been spawned under laboratory conditions and the larvae cultured and planted in subtidal grounds (under about 40 feet of water) at an age of about 8 weeks. About 12,000 were planted last spring and researchers hope to plant several hundred thousand this winter and spring. Keeping the clams alive through the larval stage and protecting them against disease until they set are reportedly the main problems . . . .

. . . . **Significant numbers of larger and older chinook** salmon in Washington States' 1976 returns may signal that hatchery rearing programs are starting to pay off with good survival rates and larger, better quality fish, according to Department of Fisheries officials. The Department is especially interested in the 1976 returns of 5-year-old chinook to the Olympic Peninsula's Elwha River where work began in 1971 to restore a run of traditionally large chinook. Largest of the 1976 returns were in the 40-50 pound range . . . .

. . . . **Texas anglers spent $233,995,000 on saltwater fishing** trips in 1975, the Texas Parks and Wildlife Department reports. The amount includes the cost of such related activities as picnicking, swimming, camping, etc. while fishing, but not for boats, motors, fishing tackle, and other equipment used on more than one trip. Sales of bait, lures, and fuel alone accounted for $56,010,000. The anglers also spent some 17,780,000 days fishing in Texas' saltwater bays and the gulf waters in 1975 . . . .

. . . . **More than 20,000 old tires**, sank about 13 miles off South Carolina's Hilton Head Island, provided the down payment on that states' ninth artifical fishing reef last fall, according to the Wildlife and Marine Resources Department. Reef cosponsor, the Georgia Department of Natural Resources, will add additional materials later. Some black sea bass already inhabit the reef area and good fishing is predicted for this spring. Other species expected there eventually include snapper, grouper, porgy, and possibly cobia and king and Spanish mackerel . . . .

. . . . **The Oyster Culture Section of Florida's** Department of Natural Resources planted two new oyster reefs last August, according to the *Florida Conservation News*. One was planted between Cocoa and Melbourne in Brevard County; the other at East Bay, near Allanton, in Bay County. Both 3-acre sites were built in the general configuration of a natural oyster reef. Cured and uncured scallop shells were used for the Brevard reef while East Bay reef materials were out-of-state oyster shells and cured scallop shells. Each site has an estimated potential annual production of 350-400 bushels of oysters . . .

. . . . **California Department of Fish and Game fish hatcheries** report planting 57,886,527 fish, weighing 4,109,681 pounds during 1974-75. The figures are up from the 1973-74 totals of 47,889,741 and 3,822,420 respectively. Anadromous fish, accounting for 32,996,023 of the fish and 830,267 pounds of the weight, included 28,692,579 salmon weighing 577,114 pounds and 4,303,444 steelhead trout weighing 253,153 pounds. Catchable and subcatchable trout, fingerling resident trout, and aged trout broodstock accounted for 24,024,614 of the total number of fish and 3,145,188 of the total poundage. Warmwater fish plants amounted to 865,890 fish weighing 134,226 pounds. The cost of operating all state fish hatcheries during the year was $4,299,898 . . . .

. . . . Florida's Department of Natural Resources **conducted an intensive snook tagging program in mid-1976**, reports the *Florida Conservation News*. About 4,000-7,000 snook were expected to be marked with both dart and internal streamer tags. Anglers, who get $2.00 for each returned tag, were asked to provide all the catch data (length and weight of the snook; where and when caught). Meanwhile, a year-long creel survey is underway to further document and evaluate the snook fishery. The tagging was directed by the DNR's Marine Research Laboratory and the Collier County Conservancy . . . .

. . . . **Maryland's new oyster research hatchery**, at the Horn Point Environmental Laboratories (HPEL) new Cambridge, Md., could "Significantly improve production of oysters on specific bars in Chesapeake (Bay) waters", according to a *Commercial Fisheries News* (Md.) report. The hatchery's objective is to help rehabilitate depleted oyster populations. Researchers are now studying spat planting density on various bottom types for maximum growth and survival and ways to modify hatchery techniques to reduce spat costs, now about a penny apiece for 3/4-inch spat. Spat from the hatchery could also help in rehabilitating oyster bars when natural spat set fails . . . .

. . . . **A 33-pound striped bass, free 17 years and 5 months**, has set a new record for a bass carrying a California Department of Fish and Game tag. The fish was tagged near Prisoners Point in April 1959 and was finally retaken in September 1976 near Suisun City. The 43-inch striper was about 23 or 24 years old when caught and biologists estimated the fish's age at about 6 years when tagged as a 27-inch, 8-pounder in the San Joaquin River . . . .

. . . . **Logbooks kept by Alaskan troll fishermen last summer** are expected to add significantly to understanding salmon biology and behavior, according to the Alaska Department of Fish and Game. Last spring over 100 trollers began daily logbook recordings of position, catch, water temperature, and other observations. The logbooks were distributed by the Ketchikan Alaska Trollers Association. Data is being analyzed by researchers with the National Marine Fisheries Service (NMFS), the University of Alaska's Sea Grant Program, and the Alaska Department of Fish and Game . . . .

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